AMERICAN
DYESTUFF REPORTER

VOLUME XXII JANUARY 30, 1933 NUMBER 3

The European Dye Cartel in World Trade

By C. C. CONCANNON

Chief, Chemical Division, Bureau of Foreign & Domestic Commerce, Washington

THE European dye cartel of today is the latest development of a careful plan initiated in 1927 as a Franco-German dye marketing agreement, to which Swiss producers definitely became a party in 1929. Spain automatically came under the control of the convention when its dye industry was acquired by German interests, while German and Swiss ownership in Italian dye factories aided in the final inclusion of Italy in 1931. After years of negotiation, Great Britain recently became a signatory country, with Poland becoming the seventh and latest member of the entente. Only two European producers of importance remain outside the direct control of the pact—Russia, which is said to consume all of its own output, and Czechoslovakia, whose exports are comparatively insignificant in world trade.

For the first time since Germany's prewar supremacy the European coal-tar dye industry presents a solid front in the trade marts of the world. Predominant national groups in the dye industries of Germany, Switzerland, France, Italy, Spain and now Great Britain and Poland are directly linked in a general accord for the world-wide marketing of their products. The pact, however, is only the frame work of a control rendered more effective by the ramification of German, Swiss and French plants in other producer countries, and through the interrelations of the administrative organizations of member groups with other industries subject to international agreements, the whole structure comprising a single complicated, but definitely woven, pattern centered around the world's largest dye producer.

Although total world dye exports showed improvement in 1931 over the somewhat adverse conditions of 1930, the advance was due entirely to increased shipments from the four major units of the European dye cartel, Germany, Switzerland, Great Britain and France. The United States and Italy were the only two important dye exporters who failed to increase their shipments abroad in 1931. The seven countries now subject to the provisions of the dye pact accounted for 84 per cent of the total world exports of 160.3 million pounds in 1931, while their aggregate output is estimated to total about 250 million pounds. World export trade during the current year is undergoing severe contraction reflecting the restricted purchasing in consuming markets. Chinese dye consumption is only about 40 per cent of normal and in addition a shift is reported from indigo to the cheaper sulphur colors, similar depressed conditions being true of most world markets.

In addition sales promotion efforts of producers are being seriously hampered by the effects of such features as import quotas, depreciated currency, scarcity of foreign exchange, and increased tariffs. The depressed condition of foreign markets has also reacted on home markets, since many of the domestic dye-consuming industries are themselves also dependent on export trade to balance their sales.

The succession of agreements since 1927 has changed the complexion of competition in world dye markets, and certain fundamental variations have already been noted in the flow of trade. Not enough time has yet elapsed, so that a complete and accurate statistical analysis of its effects can be made, but still certain general conclusions may be already drawn. There follow two tables*, the first outlining the distribution of exports from dye-producing nations by consuming areas and the second showing, on the basis of their exports, the position of each of the most important producing countries as a source of the world supply of imported dyes. These statistics are based on tables which are appended to this article and are a background upon which may be superimposed the complicated structure of the world dye industry to form a fairly complete picture of international trade in this commodity group.

*See the two summary tables marked (X) on page 107.

The European dye cartel revolves chiefly around the international activities of the German dye industry. Germany is the most important single factor in the world dye trade, accounting for approximately 60 per cent of all exports in 1931. Other countries recorded as follows: United States, 13 per cent; Switzerland, 11 per cent; Great Britain, 8 per cent; France, 4 per cent; Japan, 3 per cent; other countries, 1 per cent. It is particularly true in the case of Germany, Switzerland, and France, however, that their exports are far from representing the share each country supplies of world consumption because of branch plant output in foreign countries, dyes other than of their own manufacture sold through their foreign agencies, and trade directly controlled by their agreements with other producers, as well as the large amounts sold on domestic markets.

Germany has interest in large dye producing plants in Italy, Spain, and the United States. It also owns jointly with French interests an important Swiss plant which has a branch in France. The leading French producer also owns a dye factory in Poland. Three Swiss dye producers, who have formed a sales consortium, own more plants abroad than any other one national group, with factories in Italy, the United States, Poland, Great Britain, and France. This network of factories serves to bind the interests of the members of the dye cartel more closely together, besides increasing the scope of cartel control.

Features of Agreements

The main features of the various agreements which have led up to the present dye cartel have been (1) reduction of competition through apportionment of markets, (2) allocation of export quotas, (3) maintenance of price levels, and (4) in Germany, France, and Switzerland, the interchange of technical information. These main features, based on available statistical and other data are detailed in the following paragraphs.

At the present time, no matter what the character of the agreements relative to division of individual markets, Germany is the chief source for the imported dyestuffs of every geographical area except Oceania, where British dyes are uppermost. To each of the continents Germany ships more dyestuffs than all other countries combined, in 1930 accounting for 57 per cent of the total poundage supplied by all countries to Asia, 62 per cent in Europe, 54 per cent to North America, 71 per cent to South America and 62 per cent to Africa.

The various marketing agreements have as a general rule tended, it would seem, to strengthen the position of Germany in the Far East; Switzerland and France have in return received concessions relative to the European market; while in the case of Great Britain, her position is reported to have been strengthened in her widespread dominions and colonies. The importance of each one of these areas to the interested countries is evident from an analysis of the detailed export statistics. On the average 50 per cent of Germany's exports of dyes go to Asia, this area being also the chief export market of the United tates, Great Britain, and Japan, Exports from Switzerland, France, Italy, Poland, and Czechoslovakia, on the other hand, find their chief outlets in European countries. Great Britain markets usually about one-third of its dyes within the British Empire, exclusive of the home market, while France ships about one-sixth of its output to its colonies.

A second feature of the cartel agreements has been the allotment of export quotas. An oral understanding between French, German and Swiss producers existing for several years was reduced to writing in 1929, with export quotas reported as follows: Germany, 70 per cent; Switzerland, 20 per cent; and France, 10 per cent, of their combined exports. The actual participation on the basis of poundage, however, was as follows in the year of the agreement, 1929: Germany, 77 per cent; Switzerland, 18 per cent; and France, 5 per cent, compared with their relative percentages in the preagreement year, 1926, of Germany, 76 per cent; Switzerland, 16 per cent, and France, 8 per cent. During 1930 participation in their combined exports was as follows: Germany, 80 per cent; Switzerland, 16 per cent; and France, 4 per cent; while in 1931 it was 79 per cent for Germany, 10 per cent for Switzerland and 6 per cent for France.

Any allocation of export quotas that may have been made with the inclusion of Great Britain in relation to Germany, Switzerland and France, probably approximated the relative percentage of their combined exports over a period of years and may therefore not materially disturb the current status.

Price Levels

One of the objects of the cartel is said to be to maintain profitable price levels. Although specific denials have been made as to price regulation, the delimiting of competition and other factors have combined to maintain and even increase dye prices. This effect has perhaps been most evident in the case of the recent inclusion of British interests, when the prices of dyes were increased in that market approximately 10 per cent. The agreement with Polish producers is also expected by the Polish trade to increase price of dyes to the consumer in that area.

An important feature of the present dye cartel not usually emphasized is that several of the producers have interests or are manufacturers of other numerous lines. Many of these industries, such as explosives, rayon, and fertilizers, are also the subject of international ramification, affording the dye producers numerous points of contact with each other as well as with other foreign producers. In addition, these other activities afford an influence or an actual agency in foreign countries through which dye producers secure an advantageous position for the distribution and sale of their dyes.

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The Detection of Heavy Metals and Traces of Impurities in Cotton Fabrics*

By **H. M. CHASE**
Riverside & Dan River Cotton Mills

IN THE analysis of fabrics for heavy metals and other impurities the textile chemist finds himself in the field of micro chemistry, a comparatively recent and certainly a most fascinating branch of analytical work.

In an ordinary qualitative analysis, from .2 grams to .5 grams of material are taken and the analyst may feel certain of detecting any element present to the extent of .010 g. In micro analysis quantities from .000010 g. to even .000001 g. of an impurity may be under consideration.

For example, if a piece of cloth weighing .100 g. and approximately one inch square contains .000001 g. of manganese or .000003 g. of copper, it is just within the limit prescribed by the trade for fabrics to be rubberized.

In general, reactions involving .000010 g. of an element or less are termed micro chemical and the amounts are expressed for convenience as micrograms, one millionth of a gram being designated as one microgram.

There are two well established methods of detecting these minute quantities of material — that of chemical microscopy and that of spot analysis. Those interested will find the reactions and manipulations described by Chamot and Mason[1] on the one hand and by Feigl[2] on the other.

Briefly, the reactions of chemical microscopy are performed in a single drop of solution on the corner of a glass object slide and are observed under the microscope.

*Presented at Annual Meeting, Saturday morning, Dec. 3, 1932.

Aside from the latter very little apparatus is required and practically all of it can be made in the laboratory.

Strange as it may seem this method possesses a considerable advantage over the ordinary test tube reactions aside from the fact that we are enabled to deal with minute quantities of material. Nearly all precipitates are in reality crystalline and generally speaking the form of the crystals is characteristic of the precipitate under examination. Thus, what is merely a white precipitate in a test tube is a definite crystal form under the microscope, carrying as it were a plain label of its identity.

Zinc

Suppose, for example, we wish to ascertain the presence or absence of zinc in a fabric. We first obtain a solution of the suspected material. This may be done by incinerating carefully a small portion of the fabric in a tiny crucible and taking up the residue in a drop of acid or boiling in weak acid or water in a small test tube, according to the conditions under which we suspect the zinc to be held in the fabric. In any event as little solvent as possible should, of course, be used, as we know nothing of the amount of zinc possibly present.

A drop of the solution, or all of it if it is only a single drop, is placed on the corner of the glass object slide. It may be advisable to evaporate by holding the slide above a tiny gas flame and to dissolve the residue in water. In this particular case the drop should be only slightly acid. If strong acid is present it may be modified by adding to the drop on the slide a small crystal of sodium acetate.

Adjacent to the test drop and separated by a space of a few millimeters we place a drop of our reagent, in this case a solution of potassium mercuric thiocyanate, and with a platinum wire connect the two drops with a narrow channel or neck, slightly titlting the slide so that the reagent drop will slowly flow into the test drop. Place under the microscope and examine.

Other Metals

Beautiful white feathery crystals of unmistakable form show the presence of zinc. Without any change of form the crystals may have a faint lavender tint. This indicates unquestionably the presence of the merest trace of copper. On the other hand we find no zinc crystals but numerous bright yellow forms resembling delicate seaweed. They show the presence of copper in greater quantity. A little iron gives a pink tint to the drop—too much iron may spoil the test. If cadmium or cobalt were present, which is, of course, unlikely in fabric analysis, we would observe either the clear colorless definitely recognizable prisms of the cadmium double salt or the blue radiating prisms of the cobalt double salt.

Other metals which may obscure the test may happen to be present. In this case preliminary precipitation of the conflicting element may be carried out in the single drop by adding the proper reagent and decanting the supernatant clear liquid to another position for testing.

This test is one of the most striking and useful of many and is sure to make a convert to micro-chemistry when successfully carried out.

Spot Analysis

As typical of the methods of spot analysis the test for chromium as chromate may serve as an example. A drop of a solution of sodium bichromate is placed in the cup-like cavity of an ordinary white porcelain spot plate familiar to all chemists. For illustration we will adjust our test solution so that it contains a single microgram of chromium metal. It is made faintly acid by stirring with a small glass rod dipped in dilute sulphuric acid and a single drop of an alcoholic solution of diphenylcarbazide added by means of a glass rod or an ordinary medicine dropper. An immediate blue violet color develops assuring us of the presence of chromium. As a matter of fact one microgram of chromium gives a very strong test and even .01 micrograms gives a definite test.

Let us suppose that a sample of cloth has been submitted and we find that it is dyed with a direct color but that the fastness to washing is unusually good. We suspect an aftertreatment with bichromate. The chromium present, if any, will probably be partially or entirely in the form of a chromic salt and consequently not in a suitable form for the test which is designed for chromates.

A sample the size of the head of a pin is cut off and incinerated in a No. 0000 porcelain crucible which is about the size of a thimble. The ashing of this insignificant fragment takes a few seconds only. The crucible is cooled and with the point of a knife blade a very little sodium peroxide sprinkled on the ash and heated to complete fusion. The chromium is oxidized to chromate and the melt may have a yellow color if a sufficient amount is present to produce it. Add a few drops of 1:5 sulphuric acid making sure that all the melt is dissolved and touch with a bit of litmus paper to make sure that the drop is slightly acid. Then add a drop or two of the diphenylcarbazide solution. The presence of chromium is shown by a beautiful blue violet color. The acid used must be dilute and the contents of the crucible must be faintly acid to litmus. This excellent procedure is adapted from Feigl's test for chromium in leather[2].

Manganese

In similar manner we may test for manganese. As manganese is unlikely to be present in a fabric to as great an extent as other metals we will take perhaps a square inch of cloth; incinerate in the micro-crucible and fuse with peroxide. A blue green fusion makes it practically unnecessary to proceed further as it indicates the presence of manganese. If now we add as before a few

drops of dilute sulphuric acid the familiar pink color of permanganate appears, part of the manganese being oxidized to permanganate at the expense of another part which is precipitated. If the test is still not certain we add a little potassium periodate, boil the contents of the crucible for a few seconds and keep it hot some minutes longer. The pink color is intensified and one or two micrograms of manganese is indicated with absolute certainty.

Other Metals

If to the solution of the melt in acid we add a drop of ammonium-thiocyanate solution, iron which is generally present gives the well known pink or red color. Or better still we may incinerate a minute sample, add a drop of nitric acid, drive off the excess acid and fuse with a crystal of potassium bisulphate, take up with dilute hydrochloric acid and test with ammonium thiocyanate[2].

If a small sample of cloth is ashed as above and the ash dissolved in dilute sulphuric acid, the excess acid driven off and the residue taken up with a drop or two of water, made alkaline with ammonia and a drop of a .2% aqueous solution of sodium diethyldithiocarbamate added a rich brownish yellow color shows the presence of copper. One or two micrograms of copper gives a positive test. If iron is present the addition of ammonia will of course give a similar color in the solution by precipitating ferric hydroxide. In this case a drop or two of a 10% solution of potassium sodium tartrate stirred into the test solution before adding the ammonia will prevent the precipitation of the iron and the copper is thus determined without interference. If a large amount of chromium is present the grey green hydroxide may also obscure the test, but very considerable quantities may be present without detriment. Manganese has no apparent effect.

The general method of procedure has been shown by the preceding tests. If colored spots occurring on cloth are to be tested they are usually so concentrated that the smallest speck may be identified. In many cases they may simply be clipped out with the scissors, dissolved in a drop or two or acid either on the object slide of the microscope or on the spot plate and the test concluded with or without the removal of the clipping.

Method of Feigl

There is still another method of conducting spot reactions which has been developed by Feigl to a high degree, in which the analysis is carried out on filter paper. As an example we may take the detection of aluminum which forms a colored lake with alizarin.

A quantitative filter paper is wet with a saturated alcoholic solution of alizarin and dried. With a glass rod a small drop of the solution to be tested is spotted on the paper and held over ammonia which develops a violet color due to the ammonium salt of alizarin. On drying a few minutes in the drying closet the violet color disappears and if aluminum is present the spot is colored red by the aluminum alizarin lake.

Chromium, iron and manganese also form colored lakes with alizarin. In their presence the great advantage of filter paper spot analysis can be strikingly demonstrated.

The filter paper is first impregnated with potassium ferrocyanide. With this reagent these other metals form insoluble precipitates while the aluminum does not. On spotting with the solution to be tested they are precipitated in the fiber at once while the aluminum solution spreads out into an outside zone. Thus an actual precipitation and filtration is performed at one and the same time. The aluminum is now easily detected in the outside zone.

Reference to the published works given above will open up to the textile chemist a fascinating field and one particularly adapted to his needs.

Micro chemistry deals not only with qualitative analysis but with quantitative determinations as well. The work already done by some of our members on the determination of metals inimical to rubberizing borders on the micro chemical.

Estimation of Copper

It was with a view to still further extending the low limit of these determinations that the following investigation of the existing methods for the colorimetric estimation of copper was undertaken.

Regardless of the merit of the various claims as to the quantity of copper which may be tolerated in cloth which is to be rubberized, any method which is based on the measurement of even smaller quantities than can be determined by the present methods should be of value for the following reasons:

First: The preparation of the solution is the most tedious and difficult part of the analysis. The digestion method as described in the Year Book is undoubtedly the best but many mills are not equipped for it. It is difficult to either ash or digest a 10 g. sample of cloth as compared with a .100 g. sample or even a 1. g. sample. The smaller amounts may be digested in some cases even without the aid of a draft hood and with a simple Bunsen burner.

Secondly: If the damage to rubberized goods is at all in proportion to the amount of copper present, then the analysis of a colored check or stripe may be of little value. The average copper content may be well below the limit whereas a narrow colored stripe may contain copper far in excess of the limit without materially affecting the average analysis. On rubberizing any deterioration due to copper would occur along the stripe long before its effect was noticeable elsewhere.

On a sample of cloth weighing .100 g. three micrograms of copper would be .003% or the generally accepted limit. If the analysis can be made even with a possible error of one microgram it should be of considerable value.

To accomplish this result the method must be sensitive to a high degree. The most sensitive of the methods thus far applied to cloth appeared to be the potassium ethyl xanthate method. So much time was given to it that another more promising method has not yet been worked out to a conclusion, but the results obtained by the xanthate method are of some interest as they seem to explain to a certain extent the inconsistencies sometimes encountered in using this method.

The reaction upon which this method is based calls for four molecules of potassium ethyl xanthate for two molecules of cupric salt. The end product is cuprous xanthate the copper being reduced to the cuprous condition. Theoretically 1 cc. of a .1% solution of the xanthate should react with about 200 micrograms of copper. In the following experiments, however, approximately 1 cc. of the xanthate solution was used for each 10 micrograms of copper to conform with the usual practice.

Scott[3] states that for colorimetric determinations the test solution should be neutral or only slightly acid. Smith[4] found that an acidity corresponding to from .075 cc to .150 cc sulphuric acid per 100 cc of solution under examination had no ill effects on the stability of the color. O. B. Hager in the laboratory of the Riverside & Dan River Cotton Mills made the interesting observation that the initial color faded rapidly and that the time factor was therefore of great importance. He devised the method of placing the copper solutions made just acid to litmus in Nessler tubes, carefully covering with water the proper distance from the mark and then adding the xanthate solution simultaneously to both the known and the unknown, inverting both tubes at the same time and examining at once.

Check results on known solutions by this method gave excellent results. On the other hand the method of Smith in which the addition of the xanthate solution is added to standard solutions of 30, 27 and 24 micrograms of copper in sequence and without haste gave equally good results. This apparent contradiction led to considerable investigation with some rather interesting results.

As the principal object in view was to work with small quantities the first experiments were conducted with 10 micrograms more or less of copper. A standard solution of copper sulphate containing 1 microgram of copper per cubic centimeter and 1 cc sulphuric acid per liter was used. The desired amount of solution was placed in a 100 cc Nessler tube, water added carefully to within the proper distance from the mark, the xanthate solution added and the tube inverted twice and examined at once.

As the amount of acid varied with the amount of copper, tests were made to determine its effect. At 7 pH the initial color in the tube is very stable but does fade slowly. With varying degrees of acidity up to 1 cc sulphuric acid per 100 cc the initial color of 10 micrograms of copper fades in 15 minutes to approximately that of 2 micrograms viewed at once, a drop of about four-fifths in intensity. No perceptible difference however in the rate of fading could be detected with different amounts of acid from 1 cc down to .075 cc per 100. As it is not easy to secure exact neutrality it seemed preferable to work with slightly acid solutions.

It follows from the preceding that if two tubes containing 10 micrograms of copper each are made up one after the other the second should be of heavier color than the first. This is true, the difference when made up only 30 seconds apart being very striking. In four to five minutes after making up the second tube however it becomes practically indistinguishable from the first, although both tubes have faded to about four-fifths of their initial intensity.

At this concentration, i.e., approximately 10 micrograms of copper per 100 cc a difference of 1 microgram can be detected with certainty if the zanthate is added to each at the same time, the tubes promptly inverted twice to thoroughly mix the contents and examined at once. The operation requires 15 to 20 seconds.

Thus 9 micrograms of copper can definitely be distinguished from 10 micrograms. In making this comparison another phenomenon appeared as shown by the following experiments:

Two tubes were made up No. 1 containing 9 micrograms of copper and No. 2 containing 10 micrograms. The xanthate was added simultaneously and the tubes inverted and compared as usual.

Table 1.

At the start No. 2 was definitely heavier in shade.
At 1 minute—tubes were indistinguishable.
At 2 minutes—tubes were indistinguishable.
At 3 minutes—No. 2 barely heavier.
At 4 minutes—No. 2 barely heavier.
At 5 minutes—No. 2 definitely heavier but not as much so as at the start.
At 10 minutes—Same relation.

This experiment repeated with 7 micrograms copper in tube No. 1 and 10 micrograms in tube No. 2 gave the following result:

Table 2.

At the start No. 2 very definitely heavier.
At 1 minute—No. 2 heavier but less difference.
At 1½ minutes—No. 2 heavier but still less difference.

At 2 minutes—No. 1 heavier by a very slight difference.

At 3 minutes—No. 2 heavier by a very slight difference.

At 4 minutes—No. 2 heavier by an increasing difference.

At 6 minutes—No. 2 very definitely heavier.

The intensity of color decreased very rapidly at first then gradually less rapidly until at the end of five minutes it was about one-fifth its original amount. For the next fifteen minutes the change was so gradual that it was hardly noticeable. Thus at this concentration comparisons must necessarily be made either by simultaneous addition of xanthate and immediate examination or by delaying observation for at least five minutes.

From Table 2 it appeared that the slightly more concentrated solution of tube No. 2 decreased in intensity of color at a more rapid rate than that of No. 1 at first then at a slower rate until what might be termed equilibrium between the two tubes was established at the end of five or six minutes.

Repeating this experiment with 14 and 20 micrograms of copper the same phenomenon was observed but equilibrium was established at the end of a shorter period—about four minutes.

Repeating it again with 21 and 30 micrograms of copper equilibrium was established in about three minutes. Moreover the point at which No. 2 became indistinguishable or nearly so was nearer to the starting point—about thirty seconds in the last two trials.

No colorimeter being available the following experiment was made with Nessler tubes to further examine the effect of concentration on the same amount of copper:

To each of two tubes 10 micrograms of copper was added. No. 1 was filled to the 50 cc mark with water and No. 2 to the 100 cc mark. The concentration of No. 1 was therefore twice as great as that of No. 2. The depth of No. 1 was however one-half the depth of No. 2. If concentration had no influence both should have the same intensity of color on adding the xanthate, as the concentration times the depth would be the same in each tube (neglecting the small added volume of xanthate).

The result was striking. No. 1 was very much lighter in color than No. 2 and equilibrium was not established for ten minutes.

It should be mentioned that in all the experiments made the tubes exhibited turbidity and that this turbidity gradually increased on standing. In weak concentrations such as 5 to 10 micrograms of copper per 100 cc this turbidity was barely discernible as a faint opalescence and developed slowly. As the concentrations become greater the turbidity is greater as might be expected. It also develops more rapidly until at 60 micrograms per 100 cc its appearance is practically instantaneous. Coincident with this effect the high initial intensity drops with greater and greater rapidity until at 60 micrograms of copper per 100 cc its drop is also practically instantaneous and the color of the tube is the lighter shade designated in the above experiments as "equilibrium." In the case of 60 micrograms of copper per 100 cc the intensity is about that of 20 micrograms per 100 cc viewed at once.

Above 60 micrograms of copper per 100 cc still another phenomena was observed. If for example tests are made on 120 micrograms per 100 cc five minutes apart the second test instead of being heavier is now lighter. Both tubes are turbid and must be viewed over a strong light to get the full effect, preferably a 100 watt Mazda lamp screened with white bond paper and a piece of daylight glass. As before equilibrium is reached on standing, in this case in about fifteen minutes.

It was also observed that in these higher concentrations the turbidity gradually acquired a greenish opalescence. Possibly the particles gradually increase in size producing the observed effect of a gradual increase in color intensity.

As the concentration is lowered from 120 micrograms copper per 100 cc this effect also diminishes until at 60 micrograms per 100 cc it also vanishes and at this point we have practically a constant color intensity lasting for at least fifteen minutes or more.

Thus in the vicinity of 60 micrograms per 100 cc the xanthate method is satisfactory either by simultaneous observation or by observation in sequence. Outside of this zone simultaneous observation must be followed or sufficient time allowed for equilibrium to be established otherwise very great errors may be introduced.

From these and many other observations the following strictly hypothetical conclusions were drawn:

First: The color observed in the xanthate method is derived from two sources; that of cuprous xanthate in solution and that of cuprous xanthate in suspension.

Second: The intensity of the former is approximately four or five times as great as that of the latter for equal amounts of copper.

Third: In very weak concentrations precipitation is visibly delayed but does occur even at 10 micrograms of copper per 100 cc. During this delay the color of the cuprous xanthate in solution is visible.

Fourth: As concentration increases precipitation is more and more rapid until at 60 micrograms per 100 cc the color due to solution is visible only by immediate observation.

Fifth: Above 60 micrograms of copper per 100 cc the observed color is due entirely to the precipitate and its gradual increase in intensity on standing may be related to coagulation and particle size.

The various phenomena observed appear in the following experiment. This was done in 50 cc tubes to conform with what seems to be the more general practice.

The stated amount of copper was added to one of two tubes, water added and the contents of the tube mixed leaving enough space for the xanthate solution. The xanthate was added (1 cc of .1% aqueous solution per 10 micrograms of copper) and the contents again mixed by inverting.

Five minutes later exactly the same procedure was carried out with the second tube and the color compared immediately with that of the first tube. The time at which the tubes became alike is measured from the time at which the second tube was made up.

Table 3.

Cu (micro grams)	Concentration per 100 cc.	Comparison as to Color (Tubes made up 5 minutes apart) 1st Tube	2nd Tube	Equilibrium as to color.
80	160	Heavier		15 minutes
70	140	Heavier		23 "
60	120	Heavier		14 "
50	100	Slightly heavier		5 "
40	80	Just visibly heavier		6 "
30	60	No visible difference in color		0 "
20	40	Just visibly heavier		2 "
10	20	Distinctly heavier		4 "
5	10	Distinctly heavier		4 "

Note: Obviously if the tubes were examined at less than five minutes apart the region of reliability would be somewhat more extended.

A more recent method of determining copper colorimetrically and one which seems better adapted to the needs of the textile chemist is based on the reaction between cupric salts and the sodium salt of diethyldithio carbamic acid [5]. It has been adapted to the determination of small amounts of copper in blood by McFarlane[6] who states that the color of the copper salt is independent of the pH of the solution and that the salt is soluble up to 15 micrograms per 10 cc of water and to a still greater extent in amyl alcohol.

The reaction proceeds best in slightly ammoniacal solution which of course requires in the case of fabrics the removal by filtration of those substances precipitated by ammonia.

The relative sensitivity as compared with the xanthate method is difficult to determine owing to the difference in color of the solutions the carbamate copper compound being a browner tone of yellow.

Comparison in Nessler tubes showed that the apparent depth of color given by 2 micrograms of copper is approximately equal to that given by 10 micrograms by the xanthate method after the color of the latter has reached equilibrium. If the xanthate test is examined immediately the depth of color is about the same by either method.

The color is stable and shows no sign of turbidity or change in intensity.

The majority of the experiments made on this method were with 2 to 4 micrograms of copper representing .002% to .004% on .100 g. of cloth.

The amount of carbamate .2% aqueous solution required was found to be approximately .5 cc per microgram of copper.

For quantities of copper over 10 micrograms the copper solution is made slightly alkaline to litmus with ammonia the carbamate solution added and mixed and the resulting color compared with the standard in Nessler tubes as usual.

The operation can be conducted in the Nessler tubes without preliminary treatment in beakers.

For quantities of 2 to 4 micrograms of copper various methods were tried using amyl alcohol to extract the copper salt from its aqueous solution in order to increase the intensity of the color.

Removal of the small alcohol layer from the extraction and filtering it to remove suspended moisture according to McFarlane's method[6] was tried and abandoned as no colorimeter was available and a simpler method suggested itself. This was based on the method used by Williams[7] for the determination of iron by the thiocyanate method. The ferric thiocyanate was extracted by amyl alcohol and ether in glass tubes one inch in diameter and evidently examined as it stood without transferring.

No special glass tubes being available several small weighing bottles of about 20 cc capacity and 25 mm diameter were selected, care being taken that the selected bottles were of the same diameter. The copper solutions to be tested were made to exactly 10 cc each this volume being well within the limits of volume required for the preliminary precipitation of other metals by ammonia and separation of the copper by filtration. The micro filter of Pregl[8] makes this a comparatively simple operation.

The solutions were placed in the weighing bottles, made just alkaline to litmus with ammonia, exactly 4 cc of purified amyl alcohol added followed by 2 cc of .2% carbamate solution, the bottles shaken gently and the alcohol layer allowed to settle until clear.

The color comparison was then made by looking through the alcohol layer sidewise against a white background. The color was of good intensity and the difference between 2, 2.5 and 3 micrograms of copper was unmistakable. This corresponds to .002%, .0025% and .003% on .100 g. of cloth.

The alcohol should be measured and the volume of the aqueous solutions kept the same in each bottle in order that the extraction by the alcohol and the resulting concentrations shall be proportional to the amounts of copper contained in the aqueous solutions.

The results are encouraging and it seems probable that

a little further investigation may develop a simple and satisfactory micro method for copper in textile fabrics.

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[3]—Scott Standard Methods of Chemical Analysis, 4th Ed. Vol. 1, p. 197.
[4]—Smith, American Dyestuff Reporter, September 15th, 1930.
[5]—Callan & Henderson (1929) Analyst 54, 650.
[6]—McFarlane. (1932) Biochemical Journal.
[7]—Williams. Journal of Dairy Research 3, 93-100 (1931).
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DISCUSSION

President Wood: On account of the lateness of the hour I am afraid we shall have to curtail any extended discussion on this very interesting paper but if anyone desires to discuss it quite briefly we can allow about three minutes for that purpose.

Mr. George Horne: I should like to ask Mr. Chase one question. In taking the sample of cloth for analysis in what condition do you take it, that is, so far as moisture content is concerned?

Mr. Chase: Mr. Horne, I am not sure about that but I think the usual custom is to take it under normal conditions of moisture content. If Mr. Smith, our Research Associate is here, he can tell you more about that than I can.

Mr. W. C. Smith: I think, as you say, that normal moisture content would be used. But isn't it true, Mr. Chase, that the moisture content would be rather unimportant in cases where a very small amount of metal is involved?

Mr. Chase: Yes I think so Mr. Smith. As far as I know no one has ever endeavored to make any specifications along that line. If the cloth contains 2½ or 3 one-thousandths of one percent of copper based on its bone dry weight the percentage based on the moist weight would be practically the same within the limits of error as there is seldom more than 6% of moisture present.

President Wood: There are two more papers on the program for this morning but we are going to ask the gentlemen who are to present those papers to do so this afternoon as there will be two papers on this afternoon's program that will not be presented and that will leave us a little more time for the business meeting which will take place immediately if the secretary will step forward to the table here.

. . . . The scientific session was adjourned and the business meeting took place. (See last issue.)

The Application of the Results of the Study of

The Isoelectric Point of Wool

To Some Practical Problems*

By **MILTON HARRIS**
Research Associate of the A.A.T.C.C.

AT the annual meeting of this association in Boston in 1931 I presented a paper which dealt partly with the theory and determination of the isoelectric point. It was the purpose of that paper to leave with you a conception of a few of the more fundamental properties of silk and wool. It is the purpose of this talk to continue from that point and to show how the results of such a purely theoretical investigation on the isoelectric point of wool is now being applied to practical problems in textile manufacture.

For the benefit of those who were not present at that meeting and to refresh the memories of others, I should like to present a few elementary definitions and a very brief discussion of the theory of the isoelectric point.

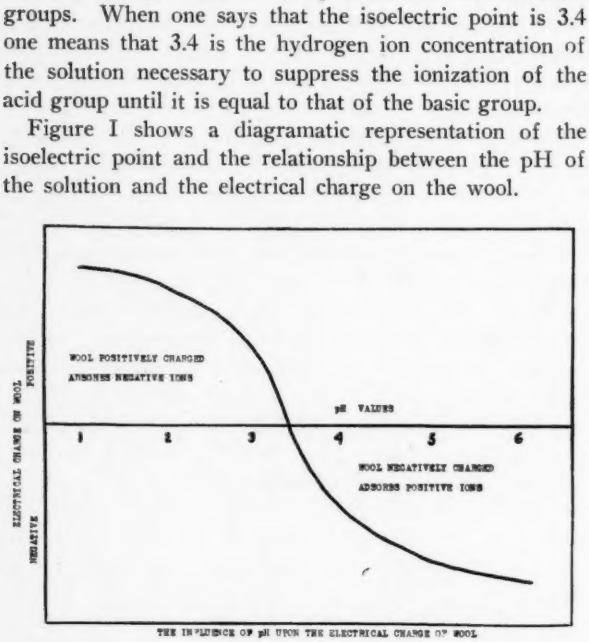
An acid may be defined as a molecule, electrically neutral in itself which yields by dissociation positive hydrogen ions (or takes up negative hydroxyl ions). Similarly a base is defined as a molecule which gives off negative hydroxyl ions or takes on positive hydrogen ions. An amphoteric substance is one that combines both of these properties; in other words it is capable of ionizing either as an acid or base. Since it has both acidic and basic properties, it follows that it is negatively charged in alkaline solution and positively charged in acid; that is, it acts as an acid in basic solution and as a base in acid.

The isoelectric point may be defined as equal to the reaction of neutrality; that is, the point at which the concentration of the positive ions is equal to the concen-

*Presented at Annual Meeting, Saturday afternoon, Dec. 3, 1932.

tration of the negative ions. If we have an amphoteric substance with an acid isoelectric point, we must add enough acid to its solution to repress the ionization of the acid groups until it is equal to that of the basic groups. When one says that the isoelectric point is 3.4 one means that 3.4 is the hydrogen ion concentration of the solution necessary to suppress the ionization of the acid group until it is equal to that of the basic group.

Figure I shows a diagramatic representation of the isoelectric point and the relationship between the pH of the solution and the electrical charge on the wool.



THE INFLUENCE OF pH UPON THE ELECTRICAL CHARGE OF WOOL

Figure I.

The determination of the isoelectric point involved a study of the simplest case of the absorption of ions by wool; namely, the absorption of hydrogen and hydroxyl ions. From it we obtained a curve relating the electrical charge on the wool to the pH of the solution in which it is immersed. It is this relationship that has given a new method of attack of many of our practical problems. It may be regarded as a tool, the intelligent application of which may prove very valuable in predicting or accounting for chemical reactions related to textile processing.

The combination of wool with ions was carried a step further by making a qualitative study of the combination with salts which give colored ions or ions which may form colored compounds on treatment with the proper reagents. It was found that wool combines with ferrocyanide ion up to about pH 5.0 and with nickel ion down to about pH 2.0. In other words, wool may combine with both positive and negative ions within a certain range on both sides of the isoelectric point. Values for the isoelectric points of some proteins have been obtained by other workers based on such experiments. It is necessary that the ionization of the protein be zero at the isoelectric point if these combinations are to be used as a method for its determination. However, it is easily proven that the ionization of an amphoteric substance at its isoelectric point is not zero but is at a minimum. The results obtained in our experiments indicate that the value of 4.8 for wool obtained by other workers does not represent the isoelectric point but indicates the point above which wool will not combine with negative ferrocyanide ions.

From the studies of the adsorption of colored ions by wool it became very apparent that there probably existed a definite relationship between the quantity of a dye absorbed and the electrical charge on the wool.

Since acid dyes are negatively charged they should be most strongly absorbed on the acid side of the isoelectric point; similarly basic dyes should be greatly absorbed on the alkaline side.

The chief difficulty in making this particular study was to obtain dyes which did not change solubility or tend to precipitate with change of pH, also ones which do not change color with change in pH; in other words, do not exhibit an indicator effect. The potassium salts of the indogotine sulphonic acids were found to conform to these requirements. They also had one more advantage—they are obtainable with 1, 2, 3 or 4 sulphonic acid groups.

All of the dyeings were carried out at 25° C using .02 gram of the dye per gram of wool. The pH of the solutions were carefully controlled by employing the proper buffer mixture. At various intervals, 5 cc aliquots were taken from the mother liquor and the quantity of dye remaining determined by measuring the spectral transmittancy of the dye solution.

Figure II shows the influence of pH on the adsorption of potassium indogotine, tetra-sulphonic acid.

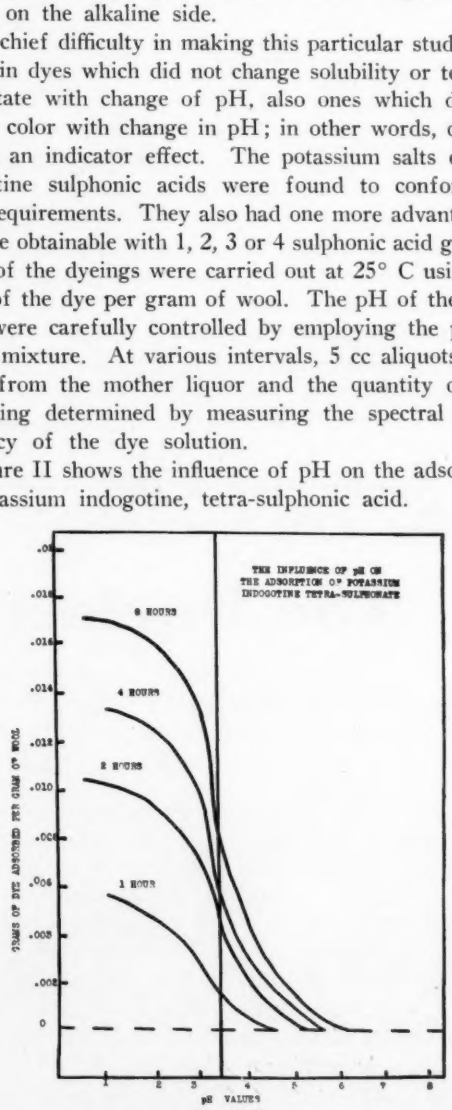


Figure II.

Other experiments now in progress not only confirm these results but also show that there is much valuable information to be gained by these studies.

Another process which may be studied from this standpoint is that of carbonization. The term carbonized wool is a misnomer. In reality we carbonize the cotton and vegetable matter. However, since the wool is also in contact with the acid and may be damaged by it, any information obtainable along these lines is of considerable value. What happens when wool is carbonized? The wool is treated with approximately a 5 per cent solution of H_2SO_4, dried and heated up to 100° C. or even higher. The vegetable matter is carbonized and is removed by mechanical treatment. However, when the wool- vegetable matter mixture is put in the acid solution, the wool becomes positively charged. The sulphate ions will be strongly absorbed. Moreover considerable sulphuric acid is allowed to remain on the fiber. After the carbonization takes place the acid is removed. If the wool is simply washed in pure water some of the acid will come off and as the pH of the water will be immediately lowered the wool will again become positive and tend to hold the acid. This accounts for the usual difficulty in removing acid from wool simply by washing. However, if alkali is added to the bath, the wool becomes negative and tends to give off the acid which is immediately neutralized by the excess alkali.

One of the difficulties in carbonizing is to get the acid to penetrate into the burr. The use of wetting agents has been suggested. Since all of the wetting out agents are negative radicals it is to be expected that in acid solution they will be strongly absorbed by the positive wool. Dr. Neville of Lehigh University has shown this to be the case in studying the influence of pH upon the adsorption of wetting agents on wool (Fig. III).

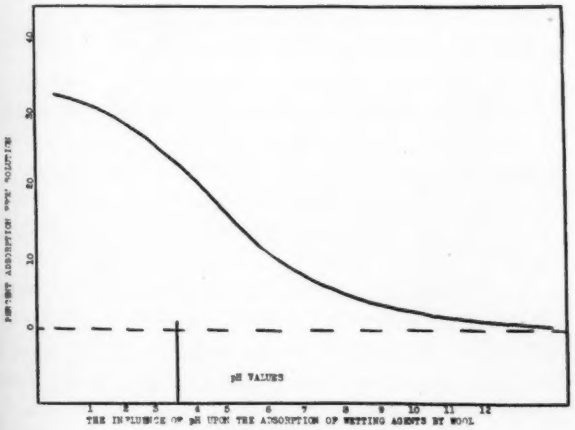


Figure III.

Since most wetting agents are fairly expensive, it is readily seen that the cost would be prohibitive; also that the agent would probably be more effective in wetting the wool. Along these lines, it might be well for some enterprising company to make a positive wetting agent, probably a substituted ammonia.

The ideal carbonizing agent would necessarily be one that under proper conditions have the same charge as the wool and also be capable of disintegrating the vegetable matter.

Effective scouring of wool is largely dependent on the pH of the scouring liquors. In general these are solutions of alkaline substance like soap, sodium carbonate, etc., giving the solution a pH of about 10. From figure 1 it is seen that at pH 10 wool is negatively charged. Wool grease, fatty acids, oil droplets and suspended material in general are also negatively charged. It is obvious that the wool will tend to repel these substances; that is, they will be least adsorbed by wool under these conditions.

Many of the points brought out in this talk are the results of preliminary experiments along these lines. The research has been of great enough importance and interest to warrant the continuation of this work in 1933.

Discussion

President Rose: Is there any discussion of this paper by Dr. Harris?

Dr. Pierce: Dr. Rose, there is one point Dr. Harris didn't touch on that isn't quite clear in my mind.

Wool may have a definite chemical composition, considering it as wool. We might set the formula down. But there is a biological difference in wool. We take a clip from the skin of the sheep at the extreme end and without disturbing it or carding it, dye it. Next to the flesh you will get an intense color. Out on the end it will be very pale. Sometimes you will make a mixture of Australian wool, domestic wool, South American wool and you get a hodge-podge. It is all wool. It all has the same chemical composition but it all dyes differently.

Has that point been considered?

Dr. Harris: There is one thing to consider and that is whether it is of the same chemical composition. I have never seen two samples of wool that would analyze exactly the same in nitrogen or sulphur. We can run those analyses absolutely accurately. That is one point.

The iso-electric point itself does not change appreciably with very small changes in composition. That is due to the fact that we have a tremendous number of these amino groups and carboxyl groups. They don't all function. Only a few of the strongest ones function and tend to give the wool its amphoteric properties. Therefore a small change of one or two groups could still give us the same iso-electric point.

That problem of dyeing tip end wool—I think that is what you are referring to—has come up and is one of the problems under consideration for research. I know of one plant that is interested in it and working on it

and one of the conclusions they have come to is porosity. They found that wool that has been exposed, that is the tip of the wool, is much more porous than the wool at the base which is much firmer and tends to act as a resist. That is, the wool on the tip tends, I think you will find to dye darker than the base.

Dr. Pierce: It was light.

Dr. Harris: All the experiments I have seen are just the opposite. Didn't you have some experience with that, Professor Olney?

Professor Olney: We have found it works both ways as far as that is concerned. (Laughter)

We had a number of samples that were a little bit out of the ordinary that absorbed more at the tip end than they did at the other end. But I think on the whole we found more less dyed at the end than towards the base of the skin. That is a subject that really is puzzling. We did quite a little work on that at Lowell three or four years ago and we are rather hoping that some of this work that Dr. Harris is doing may shed a little light on that.

Dr. Pierce: It is quite remarkable. There is a class of dyestuffs our concern has brought out that contain chromium in the molecule that are likely to give varying shades on different kinds of wool.

Dr. Harris: I don't think there is any doubt but what there is some difference in the wool.

Here is another experiment you can do: take a concentration of alkali that will not dissolve healthy wool, take exposed wool and dip in the alkali and the exposed end will dissolve. It certainly must be more reactive.

Dr. Pierce: Possibly it is the weather.

Dr. Harris: I am glad you brought that up because all the samples I have seen have always dyed a deeper shade. When I say "all of them" that probably constitutes a half dozen samples.

Professor Olney: When your wool weathers it would be the amino portion there that would be likely to change more than the other, wouldn't it?

Dr. Harris: I think so.

We did some experiments on the photo-chemical decomposition of silk and we could measure the amount of ammonia that splits off and comes off as free ammonia nitrogen. I am inclined to believe that also happens in wool. We find a decreased amount of nitrogen per given weight in the silk remaining after exposure, and we find an increased amount given off as free ammonium nitrogen.

Professor Olney: If that is the case, with a basic dyestuff you would expect more to go on the tip end than had been weathered, wouldn't you?

Dr. Harris: I think you could predict that. I saw same samples dyed with Methylene Blue and that was actually what happened. They will absorb more Methylene Blue. It may have been that all the samples I saw were dyed with basic dyes. That would account for it. I can't say as to that.

Mr. Alan A. Claflin: Wouldn't that explain the dyes that Dr. Pierce refers to that are strongly acid dyes? They would be absorbed on the base.

Dr. Harris: On the healthy part of the fiber.

Mr. Claflin: That would explain the difference in those dyes, the difference between them and the more neutral dyeing dyes.

Dr. Harris: There would be one difficulty. When you come to determining constitution of proteins like wool and you attempt to take the tips off it would be very difficulty to decide where the tips started and where the healthy fiber ended. That would be the greatest difficulty probably in that problem.

If we were going to do it, we would do this: we would actually take uniform samples of good healthy wool, take half of it and guard it very carefully, and expose half of it to the most severe exposure conditions we could find. We find that rapid ageing parallels natural ageing pretty closely, maybe not exactly but closely enough for all practical purposes. Then we would try to determine what happened on that wool. I think that would be the right way to do it.

Dr. Pierce: There is just one thing more. I can send you a wetting out agent of the alkylated sulphonated naphthalenes, which is positive instead of negative.

I think we are the only people who have such a thing and I shall be glad to send you a sample of it.

Dr. Harris: I would appreciate that. I have been looking for one of those for a long time.

President Rose: There is one thing I should like to ask Dr. Harris and that is whether he is not making his statement regarding the efficiency of soap as contrasted with detergency of other materials a little too broad when he says that nothing equals soap, without saying, "under certain conditions?" For instance, in distilled water, let us say.

Dr. Harris: Of course, we don't have distilled water when we put soap in. I don't know—

President Rose: I mean, for instance, if the water is hard our experiments show that there are much better detergents than soap.

Dr. Harris: Of course there is one thing certain: that if you buffer your solution below pH 7, you cannot use soap. That is what I referred to. And that wasn't distilled water. I do think that pH plays a tremendous part there, sometimes I think even more than the wetting out ability of the material.

President Rose: Is there any further discussion?

The next paper is one on, "Mercerization of Cotton for Strength," by Mr. Appel. Mr. Appel unfortunately is unable to be here. Professor Olney has an abstract of his paper and he will read that to us.

Professor Olney: Mr. Appel asked me to read this short abstract of his paper. The complete paper will be published later in the Proceedings.

The work was done by J. B. Wilke, Assistant Chemist of the Textile Section, Bureau of Standards.

. . . Professor Olney presented a short abstract of Mr. Appel's paper. . . .

MERCERIZATION OF COTTON FOR STRENGTH
(Abstract)

THE mercerization of cotton yarn was studied at the request of the National Advisory Committee for Aeronautics with the object of determining the conditions for the production of yarn having the maximum strength for a given weight. Experiments were conducted under strictly controlled conditions varying the tension on the yarn, time and temperature of mercerization, and concentration of caustic soda. Yarns varying from count 10 to 90, some of them in a series of twists, were mercerized. A thorough pretreatment of the yarns was found to materially increase their strength. The strength was increased further by mercerization and the maximum increase was obtained by using sufficient tension to prevent the yarn from contracting in a caustic bath. The time and temperature of mercerization and the concentration of caustic need not be carefully controlled, though somewhat greater strength results when the concentration is low, say 10%, and the temperature is kept at 0° C. or lower. The results clearly indicate that the twist in the yarn must be low if the maximum increase in strength is to be obtained. The strength of properly selected yarns can be increased 50% or even 100% by pretreatment and mercerization.—By J. B. WILKIE.

Discussion

Professor Olney: While I am not in a position to discuss this paper at all I think if any of the members have any statements to make in regard to it they might go right into the proceedings and be of some value.

President Rose: Is there any discussion of this abstract of Mr. Appel's paper?

The next paper on our program was to be one on, "Physical-Chemical Aspects of Cellulose and Rayon," by Mr. H. D. W. Smith, but he is not here and so we will pass on to the next paper which is my own, so that I have the great advantage at this time of allowing myself as much time as I like. The only thing is that I haven't any time so I am going to make it just as short as I can. (Laughter)

. . . President Rose presented his prepared paper, entitled, "The Building of Molecules for the Textile Industry," illustrating with slides. (See last issue.)

Students of Today—

The Textile Dyers of Tomorrow*

By **ALBERT H. GRIMSHAW**
North Carolina State College Textile School

FOR quite a number of years it has been a pleasure to me to see these students of today become the textile dyers and chemists of tomorrow. At graduation time, some of these young hopefuls rush out into your working world quite often convinced in their own minds that they can show the old-timers some modern and very up-to-date methods of running the business. But do not judge all graduates by the very few cocky would-be wise youngsters.

The faculty of the textile schools are continually trying to impress on the student that he will find that his work and study at school has simply been a start in really learning how to study, so that when he does finally get started in the cold old business world, he may have some knowledge of the use of the tools used in college. These tools, of course, being his books and other data used in his studying of the art of dyeing, bleaching, finishing and printing fibers and fabrics. Of course, if he has had the opportunity of the use of good laboratories and a chance to use some of the mill machinery, he is doubly fortunate. When the *real* student comes to work in your mill, he does not stop studying, he really begins to study by trying to apply the theories, as taught him in school, in a practical way under the guidance of you who have now

*Presented at Annual Meeting, Saturday afternoon, Dec. 3, 1932.

become his teachers. Your teaching of practical methods plus his own desire to keep studying under your guidance should combine with the teaching of the theories as learned in the school to make him a real dyer in the course of time. This is not accomplished in a day nor a year but takes time.

Most of the graduates realize this and a quotation from a letter of a 1932 graduate will be made: "Since I am beginning to see that I do not know much, I am starting to learn a few things." This young man is working in a bleachery and if he keeps the above idea in mind, he certainly will succeed.

The school teacher's duties do not end when you take over the job of teaching the new worker. Far from it, because it is when the graduate gets his first job that he really begins to study, and he falls back on his teachers for data which you in the mill may not be able to supply. More of this later.

Typical Experiences

But from books and trade journals now available in most of the modern plants, or from his school notes, he may at times be able to help solve some of the problems that sometimes cause trouble in the mill, Just a couple of instances:

A mill with a real good practical boss-dyer was having trouble with basic dyes on cotton. They were using a softened water so thought the water was O.K. A recent graduate breaking in as a helper wanted to test the water but the mill had no laboratory. So he took some of the water to the local high school where he made the familiar test for iron using KSCN. He found iron to be present, and when means were taken to remove the iron, the trouble was solved. He had remembered that tannin and iron would sadden dyes.

In another mill where they did a little printing as well as bleaching and dyeing, they used tapioca starch for the printing pastes and corn in the finishing. A carload of the two starches came to the plant with the starches in unmarked bags. These were unloaded before they had been sorted out. The young graduate took a microscope and examined a little from each bag and in a short time, the two starches had been identified and stored away in proper place.

Another graduate suggested the use of sulphuric acid in neutralizing some mercerizing wash water thus saving on alum which had to be used in quite a large quantity.

Another suggested a different tension in winding of beams to be used in package dyeing and the resultant dyeing was much improved.

Laboratory Work

Frequently graduates come back and use our school laboratories because the mills (in too many cases) do not have lab facilities. Recently graduates have used the labs for testing dyes, sulphonated oils; lubricating oils; softeners; rayons; starches; sizing compounds, water, etc.

Sometimes, besides not having a lab, they are unable to come and do the work themselves, so ask us to have the work done for them. The students at the school do the work under the direction of the instructors, and in this way the student gains a little idea of the problems which may confront them when they themselves start to work.

The following data is on a printed form which the student uses in making his report: North Carolina State College Textile School; Laboratory Analysis Report; Sample marked; From; Date received; Date returned; Time required; Analyzed by; Assisted by; Reason for test; Method of analysis, etc.; References; Results obtained; Conclusions. Each report is in triplicate so that one copy goes to the firm for whom the test was made, one to our Dean, and one is kept on file in the department in which the test was made. We feel that the making of such reports helps the student to become methodical in his work. It might be added here that each student is taught to keep a written account of all the various tests which he does on every problem as such references may come in handy at a future time when doing similar tests.

In my department the students not only make a report to me but also have to explain everything about the test to the other members of the class during a regular lecture period. As they have to answer questions of their own class-mates in regard to the test, the student usually has also prepared himself thoroughly on the subject.

Student Work

Since school opened this year, the students have done work on the following problems for some of our mills: Cotton Softener; Examination of mixed wool and rayon cloth for faulty scouring; Antichlor powder; Flake caustic soda; Cause of spots on finished cloth; Water from a mill pond; Water from a North Carolina city supply; Determination of % wool in mixed yarn; Amount of carbon in asbestos; Analysis of filling in a yarn; Moisture test on several sulphonated oils; Identification of dyes used in dyeing of golf hose; Identification of starch; etc.

On all of the above work, each student was required to look up and make notes on as much data as was available in regard to each test. We try to have as many trade journals as possible because the latests tests are not in text books but only in the trade journals.

Sometimes the graduates ask us to supply data on various subjects about which they have been questioned or about which they themselves desire to have information and to keep up-to-the-minute. Sometimes these questions come in groups as for instance: questions on immunizing; pH control; rubberizing; tests for sulphonated oils, etc.

The largest number of requests generally are for names of good books to study.

Letters From Former Students

Here's one from a 1931 graduate now up in Canada: "I am in the dye house of a big mill and am starting off by calling for calf rope. I want you to send me any kind of information relative to dyeing cotton, silk, and rayon that you did not dispense while I was at NCS. I have my Matthews and all your notes on dyeing and bleaching. Also send information as to where I can get some good books on dyeing." This young man graduated from the manufacturing class and had been working on that end before taking this job in the dye house.

Here is one from a student now working in Mexico; this student graduated in 1929 in the manufacturing class and worked for some time in a North Carolina hosiery mill before going to Mexico. He writes as follows: "I am working in a mill as a dyer and you should see how badly organized the dye house is, I am going to see what I can do there. They are bleaching in jiggers using bleaching powder, but do not let it settle, but add sediment and all to make the bath; as a result they have cloth which is injured. I tested the cloth for chlorine and found some present. They do not like to use sulphuric acid for antichlor but are using some powder. I am sending you a sample, I made a test and I think that it is sodium bisulphite, am I right?" NOTE, he was right.

"Could you tell me how to make the test with arsenious acid to find amount of chlorine in bleach bath? I read about it in Branegan's Popular Textile Chemistry. I will order a bleaching hydrometer as soon as I find out where I can get one.

"Also I should appreciate your sending me some information on color matching." NOTE: it took several hours to get all data for him, but we did it gladly as he was showing a willingness to try to learn.

Here are a few remarks by a graduate in the manufacturing class of 1931 who is now doing the bleaching and dyeing in a mill which produces knitted cloth. "This time it is wool and rayon knitted into cloth, then the way I am supposed to do is to boil it in soap for two hours and then rinse and bleach it, using peroxide and silicate of soda. Personally, I don't think we should boil rayon in soap for two hours. I think it weakens it and makes it feel harsh, especially when on top of this, we bleach at 160 degrees for 1½ hours." This graduate had received his orders as to methods to use from directions as used by a previous dyer at the mill, but from the above you see that he is not satisfied and wants to learn a better way.

So much for the graduates, just a word or two about original thinking by students. For instance, one student asks as follows: "If we can make cheap hypochlorite of soda solution using electrolysis, why can we not use electricity in reducing a vat color and so save on the cost of the hydrosulphite?"

Another wants to know: "Why not dissolve a softener supposedly containing soap in hot alcohol, then split out the fatty matters with acid before we use the ether extraction?"

And right often, some original idea is made by a student; true, some are rather foolish, but all show that the student is thinking, and this willingness to think should be encouraged. So later, when these students come to work for you, do not laugh at their seemingly foolish questions, but try to explain to them.

You may be pestered with those eternal questions such as WHAT, WHY and How? But try to help them to see things as you have learned to see them through experience.

You older men in the mill may not have B.S., M.S. or Doctor's degrees, but nevertheless you are teaching a higher grade than we in the colleges because you are teaching post-graduates. Try and teach these students so that they may soon obtain that P.D. degree which you all have earned; the degree of Practical Dyer.

Discussion

President Rose: That brings to a conclusion our program of papers.

I don't know whether Mr. Thompson has any more announcements to make or anything further to say. If not, the meeting stands adjourned until the evening session at seven o'clock.

. . . The meeting thereupon adjourned at five twenty-five o'clock . . .

FALL MEETING, SOUTH CENTRAL SECTION

THE fall meeting of the South Central Section of the American Association of Textile Chemists and Colorists was held at the Read House in Chattanooga, Tennessee, on the evening of November 26, 1932. Mr. Noel D. White, chairman, presided. Forty-two members and guests were present, including a number of woolen mill men who had been specially invited to hear the talk of Dr. Pierce of the Ciba Co.

Mr. S. I. Parker, chairman of the arrangements committee, presented an excellent program of entertainment during the dinner.

Papers were presented as follows:

"The Methods of Manufacturing Rayon and the Factors Which Determine its Affinity for Dyes." By W. B. Sellars, of the Tubize-Chatillon Corp., Rome, Ga.

"Some Aspects of Cotton Dyeing." By Harold Schroeder, of the Dixie Mercerizing Co., Chattanooga, Tenn.

"Wool Dyeing." By Dr. E. W. Pierce, of the Ciba Company, New York.

Respectfully submitted, ANDREW J. KELLY, *Secretary*.

Rehandling Costs of Cotton Piece Goods*

By J. ANDREW CLARK

IN bleaching, dyeing and finishing cotton piece goods, finishing plants, for the most part, act merely as one party to a contract, with the owner of the cloth, called a converter, as the second party. The finishing plant agrees not only to process the cloth as demanded by the converter but also agrees to return a definite percentage of finished cloth based on the original grey length. Any damage to the cloth may, therefore, not only affect the quality, but may also prevent the finisher from returning the required yardage. This is a condition frequently occurring and as such is recognized by the inclusion of an allowance for a small percentage of bleachery seconds at a reduced price for finishing. Any greater damage or shortage may then have to be absorbed by the finishing plant. These damages and shortages are, in general, the results of troubles occurring in the plant and the cost can usually be charged to the proper department. The losses in rehandling during process may not be so noticeable in closing the lots with the customer, especially when the rehandling results in neither shortage nor loss of quality. They are, however, expensive to the plant, and in many cases, cause presumably profitable work to actually show a loss.

The following cost values will be based merely on direct labor and cost of materials, with the charges for overhead omitted since wide differences exist in the financial structures of the various finishing plants. The usual operations of a finishing plant, in general, may be divided for cost purposes as sketched in the following outline.

GREY ROOM.
1. Grey storage.
2. Laying out.
3. Singeing.

BLEACHING:
1. Kier boil.
2. Other wet operations.
3. Mangle and white dry.

MERCERIZING:

DYEING:
1. Dyeing.
2. Drying.

STARCHING:
1. Starching.
2. Framing and winding.

FINISHING:
1. Sprinkling.
2. Calendering.

FOLDING & PACKING:
1. Inspection.
2. Put up.
3. Packaging.

SHIPPING:

Deviation from the standard routing, therefore, constitute an extra burden to the lot, whether this is occasioned by faulty routing, careless supervision or mechanician and chemical mistreatment. By first showing actual costs of rehandling and later by comparison of average costs, it is expected to show a general picture, the costs involved in some of the usual cases necessitating rehandling and deviating from the usual routing.

Costs tabulated over a period of five months in several plants show a total average value for labor and materials of $.006092 a yard for bleaching and finishing, put-up, and packing an average cloth of five yard weight. This value is exclusive of dye and starch or finishing materials cost, since small variations in either dyeing or starching formulae may show differences greater than the value for the entire cost of bleaching, and in this connection, it can be seen that rehandling may easily cost more than the entire bleaching operations.

Grey cloth is usually received in bales or on rolls and is placed in grey storage until ready for process. Should this space be subjected to excessive dampness, the cloth may show mildew stains on removal. If, however, these are not severe, the subsequent boiling and bleaching will, in all probability, correct this damage with no additional cost. Mildew is not exclusively a grey storage fault, but may occur in transit as well as water marks which frequently occur through actual wetting of the bale or roll. These stains apparently will be removed during bleaching, and probably will only be noticed after the goods have been dyed and dried.

*Paper prepared for presentation at Annual Meeting, but in author's absence was not read.

This is especially bad when it occurs on vat dyed cloth, since re-handling seldom corrects the damage entirely. Without re-handling, the loss at this point would be dependent on the amount of seconds formed and the difference in finishing price between them and first quality goods.

Other classes of colored goods can ordinarily be reclaimed by the return to the Dye House. A characteristic routing would then be, assuming a 1,000 yard roll of five yard cloth for retreatment in the jig:

Labor:

Strip on jigs	6 ends
Wash	2 ends
Sour	4 ends
Wash	2 ends
Sour	4 ends
Wash	2 ends
Redye	8 ends
	28 ends

For 28 ends at an average of 20 minutes each—

9.33 jig hours or 2.32 man hours at $.42 (4 jig rate) per hour ..... $.979

Materials: *Assuming a 2% Commercial Dye*—

6 lb. Stripping Fluid at $.18	$1.08
6 lb. Muriatic Acid at $.0175	.105
5 lb. Caustic Soda at $.0262	.131
½ lb. Solvent Soap at $.09	.045
4 lb. Dye at $.70	2.80
20 lb. Salt at $.004	.08
Materials Cost	$4.241
Base Cost, 1,000 yards retreated	$5.22
Cost per yard	$.00522
Can Dry	.000384
Total Base Cost of Rehandling, per yd.	$.005604

An average cost of dyeing these same goods originally with 2% commercial colors would be as follows:

Grey Room (Labor plus materials)	$.000217
Single	.000141
Bleach	.000306
Mangle	.000076

Dye: *Labor* (*Dyed on Jigs*)—

Straighten	1 end
In color	4 ends
Salt Rinse	2 ends
Shell	1 end
Total	8 ends

For 8 ends at average of 20 min. each, 2.67 jig hours or .67 man hours at $.42 (4 jig rate) per hour ..... $.281

Materials:

4 lb. Dye at $.70 per lb.	$2.80
½ lb. Oil at $.09 per lb.	.045
20 lb. Salt at $.004 per lb.	.080
Materials Cost	$2.925
Dyeing Base Cost per 1,000 yards	$3.206
Base Cost per yard	$.003206
Can Dry	.000384
Total Base Cost per Yard to Dry Cans	$.00433

Laying out, as its name implies, consists of opening the grey bales and laying the cloth out in a systematic manner, following which the ends are sewed together and stamped for identification. After this, the cloth may or may not be singed, or singed and desized, before proceeding to the bleach house proper. Any trouble occurring in the laying out is usually mechanical or due to carelessness in checking process orders with the plant work orders. The possibility of processing either the wrong goods or those for which no process order has been received always exists and may occasionally occur. When the wrong goods are started, there may be no other way out than an adjustment with the owner on the best terms possible as rehandling is not always possible.

Before sewing, the ends may fall to the floor and get walked over, and in the sewing, oil from the machines may spatter the cloth. The operator may, in turn, occasionally sew the face to the back of the cloth. These three faults are simply due to carelessness in operation and supervision, and can be almost entirely eliminated with the proper attention. Stains at seams rarely cause rehandling because of their position, though they affect the returns in proportion to their amount. Oil from the sewing machines fortunately is a light oil, free of graphite, and its stain usually shows up after bleaching as multiple small iron spots; the oil having been removed in the kier boil. These spots are apparent in the cloth following the chemic, but may escape detection until reaching the water mangle or white dry cans. Treatment with muriatic acid, oxalic acid or any of the various fluoride compounds will usually clear the goods. A summary for treatment of 2,000 yards of five-yard cloth in a dolly washer would then be:

Labor:

Load dolly	.66 hrs.
Sour	.50 hrs.
Double wash	1.00 hrs.
Reel to box	.66 hrs.
2.82 machine hours or .705	

man hours at $.40 (4 dolly rate) per hour.....	$.282
Labor cost per yard.....	$.000142
Materials:	
5 lb. Oxalic Acid at $.11—$.55	
Materials cost per yard.....	.000255
Water Mangle	.000081
White dry	.000225
Total base cost of rehandling per yard....	$.000703

Cloth sewed face to back may have some pieces completely spoiled for the original finish when singed on the wrong side, the amount damaged depending on the number of pieces reversed. Cloth so processed usually reaches the starch room for finishing, either in the white or dyed, and occasionally may only be detected in the final inspection. The finishing materials can be removed from the reversed unsinged cloth if necessary, especially in the case of backfilled goods, following which, the finishing operations may be repeated.

Detected after finishing, a summary for refinishing 5,000 yards of a 5-yard backfilled muslin would show, assuming redyeing to be unnecessary:

Labor:	
Desize	$.000256 per yard
Water Mangle	.000081 per yard
Can dry	.000225 per yard
Starch Range	.000821 per yard
Calender	.000110 per yard
Labor cost per yard.....	$.001493
Materials:	
12 lb. Desizing Enzyme at $.06 per lb.	$.72
120 lb. Corn Starch at $.026 per lb...	3.12
250 lb. Talc at $.020.....	5.00
150 lb. Cream Softener at $.0325...	4.875
50 lb. Gum at $.0130 per lb.....	.50
7 oz. Indanthrene Blue at $1.25 per lb.	.88
Materials cost for 5,000 yards....$15.095	
Materials Cost per yard.....	$.003019
Total Rehandling Cost per yard.....	$.004512

Singeing faults, in recent years, have been greatly reduced through improvements in design. Insufficient and over-singeing are, however, still two common sources of trouble, especially with the flame types. The former can be remedied by repeating this treatment. Over-singeing, on the other hand, cannot be improved by reprocessing though it can be minimized in the finishing. Water condensed in the gaslines, especially during the winter, may cause sputtering and uneven flames, which will, in turn, affect the quality and uniformity of this operation.

Kier boiling, as commonly practiced, consists in circulating a boiling alkaline liquid through a more or less uniformly packed column of cloth under pressure of from 10 to 25 lb. for 10 to 24 hours, according to the judgment of the bleacher. This operation is strictly a bulk proposition, kiers holding three to five tons of cloth being commonly employed, and as such, this operation is the focal point of most bleaching troubles. While the literature is prolific in references to possible faults in kier boiling, a well operated bleachery rarely encounters most of them. Intelligent experience and constant attention to details is sufficient to secure good operation. Some of the usual troubles encountered are:

1. Lime deposits—kier stains.
2. Iron stains.
3. Uneven boils.
4. Chafing.
5. Tangles.
6. Over boil.
7. Turn over.
8. Tender tops.

Without entering into a discussion of the reasons for these defects, it is sufficient to point out that the first two frequently occur together, but by no means entirely so. The remedy is usually retreatment in acid as outlined earlier, though not necessarily in a dolly washer. Lime stains free of iron are difficult to detect until part of the lot has been dyed, whereupon they show up as resists. Goods going for whites may easily reach the folding room inspection before detection. The lime prevents full absorption of the finishing paste and tint, with the resultant formation of off-color areas. This condition is usually so apparent in the case of pad dyed goods, that only a very little of the cloth would be so treated, the balance being returned to the bleach house for souring.

This is especially expensive when occurring throughout a large lot intended for vat dyeing, especially on a continuous machine. Before dyeing, the machine must be charged with reduced color, chrome and acetic acid or other oxidant, and soap, in addition to the tub of reduced color for the pad. It is ordinarily senseless to continue after the discovery of lime stains, and the dye solutions becoming useless through instability, the cloth must carry this additional element of cost unless other goods are available for dyeing with this color.

A summary of the cost of rehandling 5,000 yards of a five-yard cloth to be vat dyed copen on a continuous machine would be:

Operations:	
Sour, double wash.....	$.000150 per yard
Water mangle	.000081 per yard
Can dry	.000384 per yard
Materials:	
30. lb. Dye at $1.50 per lb.....	$45.00

38 lb. Hydrosulphite at $.195.....	7.61	
30 lb. Caustic at $.0262.....	.786	
3 lb. Penetrant at $.175.....	.525	
12 lb. Chrome at $.058.....	.696	
18 lb. Acetic Acid at $.048.....	.864	
225 lb. Salt at $.004.....	.90	
100 lb. Soap at $.062.....	6.20	
3 lb. Soda Ash at $.01.....	.03	
Total	$62.611	
Cost of supplies per yard.....		$.012522
Dyehouse Labor (Making up solutions, stock vat, etc.):		
4 man hours (2 men, 2 hr. each) at $.42—$1.68		
Cost of labor per yard.....		.000336
Total base cost of rehandling per yard....		$.013473

This is, of course, an extreme case, other color types being less expensive.

Uneven boils are usually caught before leaving the bleach house but occasionally show up in starching, through the presence of motes and non-uniformity of blueing when intended for white goods. This has the effect of practically doubling bleach house costs, increased also by the cost of starching.

Chafing in kier boiling, rarely causes rehandling, if recognized as such. This being a mechanical damage to the fabric, little or no help can be given this condition when it occurs on cloth intended for vat or sulphur colors; an adjustment with the converter may be necessary.

Tangles in themselves do not cause rehandling, but whenever one occurs in pulling a kier, the possibility exists of causing a jam at a pot-eye with the formation of crowsfeet. These are mechanical and the seriousness lies in their frequency, rehandling being of no help.

Overboiling, through excessive opening of the yarn, causes a fluffy rag-like appearance, which may not only reduce the ultimate tensile strength, but cause difficulty in obtaining the desired effect in finishing. Any correction of this condition will, necessarily, have to be applied in the starching and finishing and if remedied, the cost is negligible. Mercerizing, in some cases, will improve the appearance and here again, the increase in cost will be only that of this operation which averages $.0016666 per yard.

The time element is the most important factor in pulling a turned over kier. Two or three men may straighten a load in a couple of hours in one case and take two weeks for another. Since reprocessing is seldom necessary, the added cost becomes simply one for the extra labor and the overhead for the idle kier time.

"Tender tops" is simply a designation for oxycellulose formation occurring at the top of the kier on rare occasions. The cloth so tendered is usually not subject to rehandling inasmuch as it may be excessively damaged and unfit for further processing. Light oxycellulose formation may be unnoticed until dyeing, when it usually becomes apparent through the formation of mottled light and dark color areas. The finishing plant must assume the loss completely in the case of badly damaged goods though it may, in some cases, salvage the lightly damaged cloth by mercerization with or without tension if the desired finish will permit of this operation. The increase in cost being merely that of mercerizing or $.0016666 per yard in addition to the cost of the original dye bath wasted.

Insufficient souring after kier boiling results in the incomplete removal of lime, which as mentioned earlier, can be remedied by further souring, the cost depending on the amount of cloth having been dyed or starched before discovery in addition to the actual cost of the necessary souring and washing. An example of this cost increase has been given for lime resists when dyeing vats.

Insufficient washing on completion of the bleaching operations may result in drying traces of acid or alkali in the cloth, depending of course, on the bleaching operations. Drying the former in the cloth may affect the quality and color of the finish through partial decomposition of the tallows and sometimes the tints used in finishing. Alkali dried in the cloth in small amounts may yellow the fabric sufficiently in some cases as to prevent tinting to a bright white. Unless detected before processing, the finish must be removed, after which the cloth can be lightly bleached if off color and restarched. With colors, this condition may pass unnoticed, especially if they are not sensitive to traces of acid and alkali on heating, and especially if the acid condition is not sufficient to break down the tallow with liberation of grease spots.

Sufficient examples have now been given to show something of the toll taken from finishing plants through rehandling. With costs of 125% to 300% above the original cost being easily possible in many cases, it requires no imagination to visualize the financial effect of chronic carelessness as well as acicdental damage. Extra effort in the training of personnel, and insistance of quality workmanship with intelligent supervision will go far to minimize the necessity for much of this unproductive work.

CALENDAR OF COMING EVENTS

Meeting, Northern New England Section, March 11.

Meeting, New York Section, Feb. 24.

Annual Meeting, Chicago, September, 1933.

Proceedings of the American Association of Textile Chemists and Colorists

Heavy Chemicals

Their Manufacture and Use*

By JOHN HEALY, Jr.
Merrimac Chemical Company, Inc.

THE term heavy chemicals embraces those chemicals manufactured in large quantities, and includes sulfuric, hydrochloric, nitric, muriatic, and acetic acids, ammonia, sulfate of soda, bisulfite, and so on. These materials are the backbone of the chemical industry, and moreover, in addition to their chemical importance, have considerable economic importance as well. For instance, perhaps one of the reasons why Germany was so successful at such an early date in the manufacture of dyestuffs is the fact that they were the first to solve the problem of manufacturing fuming sulfuric acid cheaply and easily. Fuming acid is very necessary for sulfonation and nitration, essential processes in dyestuff manufacture. The recent rise of synthetic ammonia is familiar to all of us. It has been rumored that Germany's knowledge that a synthetic process was practicable was a prime factor in her willingness to go to war in 1914. That, of course, may or may not be so, but at any rate, the development of the synthetic ammonia process is the chief reason for Chile's present political disturbances.

Sulfuric Acid

From a tonnage standpoint, sulfuric acid is the most important of these chemicals. Practically all chemicals, with the exception of the alkalies, are made from or with sulfuric acid. There are about 2,000,000 tons of this acid produced in this country every year.

Two processes are used to produce sulfuric acid; the chamber process and the contact process. The chamber process produces the major portion of the acid made. It consists of burning sulfur or a sulfur-bearing material such as ion pyrite, or zinc or nickel ore to form sulfur dioxide gas. This gas is then circulated in contact with nitrogen oxides and water through large chambers made of lead in which the reaction of oxidation to sulfur trioxide and condensation of the latter to sulfuric acid takes place. The nitrogen oxides are recovered and used over again.

In the contact process, the sulfur dioxide gas is first purified and then oxidized by passage through a solid catalyst, platinum or vanadium, the so-called contact mass. The sulfur trioxide formed is absorbed in sulfuric acid to form a fuming acid which is then diluted or concentrated to the desired strength.

Although a majority of our sulfuric acid is still produced by the chamber process, contact acid is rapidly gaining in popularity. The first reason for this is that the contact process will produce an acid of any strength from one per cent to 110%. The chamber process is capable of producing an acid of only 75% strength which must be then concentrated by a separate and difficult process to make an acid suitable for many industrial uses, such as dyestuff manufacture.

The second reason is the development of the vanadium catalyst. Platinum has never been entirely satisfactory because it is susceptible to so-called poisons such as arsenic and chlorides. Consequently elaborate purification systems had to be installed to enable a platinum mass to be used successfully. Vanadium does not have this disadvantage. As far as we know, it is not affected by poisons and therefore contact plants using a vanadium mass are simple in construction and lower in cost.

Sulfuric acid is used in the manufacture of practically everything at one time or another. In order of importance the uses are first, the production of phosphate fertilizers, whereby an insoluble material, phosphate rock, is solubilized by treatment with sulfuric acid and made available as a plant food. Second, petroleum refining, where the acid is used to remove tarry matters from gasoline and lubricating oils. Third, in the steel industry for the removal of oxide scale which results from heat treatment. In the textile trade, you are all familiar with the use of sulfuric acid for the manufacture of dyestuffs, for providing the acidity in dye baths, for carbonizing, and for souring.

Materials for containers for shipment of sulfuric acid are limited to two, steel and glass. Acid down to 55 baume or 70% strength, may be shipped in steel tank cars or tank trucks. Steel drums, however, according to the regulation of the Interstate Commerce Commission, can be used for acid down to only 65 baume, about 90% strength. Small quantities of acids weaker than 65 baume must be shipped in glass carboys.

Materials for storage of sulfuric acid are limited to two, steel and lead. Acid up to 60 baume in strength can be stored in lead with safety. For the range between 60 and 66 baume either lead or steel may be used. We prefer to recommend steel if the acid is hot, lead if it is cold. Above 66 baume steel is the most satisfac-

*Presented at Meeting, R. I. Section, Sept. 30, 1932.

tory material. In storing acid in steel tanks, care should be taken to see that it is not allowed excessive contact with the air. Sulfuric acid rapidly absorbs moisture from the air and the dilute acid formed rapidly attacks the steel container.

The freezing point curve of sulfuric acid is a peculiar one. In this climate practicable commercial strengths are those below 59.75 baume and those very close, that is, within .2 baume of 66°. The strengths between 60 and 66 baume are very liable to freeze in New England winter weather. Acid stronger than 66 baume, that is 98% monohydrate or 100% and the oleums, also freeze quite readily.

Impurities normally present in the acid depend upon the process from which it is made; for instance, if made by the chamber process, the acid is liable to contain traces of lead sulfate and nitrogen oxide. Iron is not usually present unless the acid has been shipped in a steel container. Nitrogen oxides are bad actors from the textile standpoint. For instance, in the case of wool, traces will yellow wool in carbonizing and give dull shades in dyeing. Contact acid will not contain lead or nitrogen oxides but does generally contain iron. The limit of solubility of iron in 66 baume acid is not more than .01%, but unless the acid has been shipped in glass it will generally contain another .01% of insoluble iron sulfate from the container. Those of you who have steel storage tanks or buy in drums have undoubtedly noticed this accumulation of iron sulfate sludge. Iron, of course, can cause trouble such as dulling of shades and tendering if present in excessive amounts. I would like to stress the fact that the only sure way of obtaining an acid of minimum iron content is to buy it in carboys.

Aluminum Sulfate

The next of our heavy chemicals of the acid group is aluminum sulfate, of which about 300,000 tons a year are produced in this country. Commercial aluminum sulfate is ordinarily made by treating bauxite ore in crude form of aluminum hydroxide, with sulfuric acid. Insoluble impurities are settled and filtered out and the solution evaporated and crystallized.

So-called iron free aluminum sulfate is made in the same general manner but the source of alumina is a purified aluminum hydroxide rather than bauxite. This purified hydroxide is usually made by treating bauxite with caustic soda to form sodium aluminate. Iron, of course, does not dissolve and solution of other impurities such as silica is controlled by regulating the amount of caustic soda. After filtration aluminum hydroxide is precipitated from the solution by agitation with air or carbon dioxide.

The alums—soda alum, ammonia alum, chrome alum and so forth, are readily made by evaporating equimolecular mixtures of aluminum sulfate and the sulfate of the other component desired. They are in general not economical sources of alumina nor is their purity any greater than that of iron free alum. Their use consequently is very limited.

The aluminum sulfate of commerce contains only 13 molecules of crystal water in contrast to the 18 molecules ordinarily given to aluminum sulfate in the handbooks. The commercial material is generally manufactured in the basic form. The term *basic* does not mean that the aluminum sulfate has an alkaline reaction but rather that there is more alumina present than is theoretically necessary to combine with the sulfuric acid present. This is an important point in shipping alum as the common container is the burlap bag which would be readily rotted by an alum containing free acid. A basic alum has no effect. Sixty-five per cent of the aluminum sulfate manufactured is used for the clarification of water supplies. The addition of minute quantities of aluminum sulfate in the vicinity of .002% to ordinary surface or well waters results in the formation of an insoluble floc of a highly basic aluminum sulfate which on settling carries down with it the organic impurities causing color. The amphoteric properties of the aluminum ion make alum unsuitable in certain special cases. For instance, where manganese must be removed flocculation must take place around a pH of 10. Alumina is soluble at this pH and very poor results are obtained if alum is used. Similarly in the case of highly acid waters or waters requiring a large dosage of alum clarification by means of aluminum sulfate is not effective. The optimum pH for formation of alum floc is 6.2.

A word should be said here concerning the use of sodium aluminate in this connection. Sodium aluminate is alumina combined with akali and the opposite of alum, which is alumina combined with acid. Consequently, combinations of the two may be used to obtain results in cases where neither one alone would be effective. For instance, in the case noted above of waters requiring large dosages of alum, the same amount of alumina at the optimum pH may be obtained by a mixture of alum and sodium aluminate.

The other chief use for aluminum sulfate is in the sizing of paper. In this case aluminum sulfate and sodium resinate react in the presence of the paper fiber to form insoluble aluminum resinate or a mixture of insoluble rosin and aluminum hydroxide on the fiber. Subsequently drying sinters this precipitate and makes the paper more or less waterproof.

The textile industry uses very little aluminum sulfate comparatively.

The shipment and storage of dry aluminum sulfate presents no great difficulty. If handled in solution, however, lead-lined equipment or acid-resisting alloys such as Duriron must be used.

Aside from a very small amount of insoluble matter the only impurity present in aluminum sulfate is iron. This is negligible in iron free alum which contains less than .005%. Commercial alum, however, will contain up to .5% iron. At the request of the paper maker the alum manufacturer so regulates his process that the majority of this iron is in the ferrous condition, the theory being that ferrous iron forms soluble ferrous resinate which is not retained by the paper and therefore does not discolor. The ferric iron content of commercial alum is less than .01%. The ion content of commercial alum does not make it unsuitable for water clarification but would be objectionable for textile processes.

Nitric Acid

Nitric acid is our next acid for consideration. This is one of the materials whose method of manufacture has undergone a revolution in the last decade. The old process of manufacture from nitrate of soda and sulfuric acid has been practically entirely superseded by the synthetic method of oxidation of ammonia. Even the old process is dependent on synthetic methods as the raw material is generally now synthetic nitrate of soda, not the Chilean material. The ammonia oxidation process is a simple one. A mixture of ammonia and air containing about 10% of ammonia by volume is passed over a platinum gauge catalyst at an elevated temperature. Ammonia is oxidized to nitric oxide and this is absorbed in water to form nitric acid. The absorption is a relatively slow reaction unless carried out under pressure.

The principal use of nitric acid is for the nitration of organic materials. For instance, cellulose for lacquers, gun cotton, celluloid, and rayon; organic materials to form explosives and dye intermediates. A relatively small amount is used in the metal industries for the pickling of stainless steels, brass and copper. Nitric acid has been mentioned in the literature as a mercerizing agent but is hardly popular for this use.

The development of the chrome nickel alloys which are quite resistant to nitric acid has been a boon to the manufacturer of nitric in construction of his equipment but has made very little difference to him in its shipment and storage. Nitric acid used for nitration is universally shipped as a so-called mixed acid, that is mixed with sulfuric which is necessary as a rehydrating agent in the nitration reaction. These mixtures can be readily shipped and stored in steel tanks. The small lots usually required for metal treatment are shipped ordinarily in glass carboys. Recently alloy steel drums have made their appearance on the market but are not extensively used as yet. Anyone interested in storing nitric acid as such, that is without admixture with sulfuric must use one of the alloys such as Duriron or chrome nickel steel, or earthenware.

Nitric acid as it is made today is practically a C. P. material. Its most objectionable impurity in the past has been iodine which acted as an inhibitor in the treatment of brass and copper alloys. Iodine was a normal component of Chilean nitrate of soda, but the present day use of synthetic nitrates has eliminated it as an impurity.

A useful co-product of the manufacture of nitric acid by the nitrate of soda method is nitre cake, a form of bisulfate of soda. This material contains in the neighborhood of 85% bisulfate of soda and 15% of sulfate of soda and sells in the textile industry as a cheap and convenient substitute for true calcined Glauber's and sulfuric acid. It is used as such in some dyeing operations and in setting baths for rayon.

Nitre cake is a solid but as it is quite acid in reaction it must be shipped in wooden containers. Strong solutions of the material must be handled just as sulfuric acid solutions of similar strengths, that is, they require the use of lead-lined equipment.

The principal impurity present in nitre cake is iron. Nitrogen oxides should not be present but if they are generally result in dull shades in dyeing.

The synthetic production of ammonia, the present day raw material for nitric acid manufacture, is one of the chemical engineering feats of the century. The raw materials are air and producer gas. Both of these are purified by compression and distillation under pressure to get pure nitrogen and hydrogen which are then combined catalytically at extreme high pressure, in the neighborhood of 1,000 to 1,500 atmospheres, to form ammonia. It is interesting to note that in certain processes part of the purification step for hydrogen is a combination of some of the hydrogen with the small amount of carbon monoxide present to form methanol. Some ammonia is still made by the old process of distillation of gas liquor. Gas liquor is a by-product of illuminating gas manufacture and contains ammonia in addition to ammonia purities such as sulfide and thiocyanate. Distillation of this liquor in the presence of lime followed by scrubbing of the gas evolved removes these impurities and a pure ammonia results. It is interesting to note that there is no difference in the purity of anhydrous ammonia produced by either the synthetic or the gas liquor process.

The majority of the ammonia produced is intended for fertilizer use. Refrigeration is a smaller but appreciable market for it. Other interesting uses are developing. Among these may be mentioned the so-called chloramine treatment for water supplies which removes taste and odor and introduces a safety factor into the chlorination operation. Ammonia and chlorine in dilute solution under proper pH conditions combine to form monochloramine NH_2Cl. This material is a mild oxidizing agent but an effective sterilizer, consequently its action is much more effective over a longer period of

time than is that of chlorine alone and furthermore it leaves no residual taste or odors. This reaction also indicates that ammonia may be used as an anti-chlor. One pound of ammonia under best conditions will theoretically combine with 4 pounds of chlorine. Ammonia is also used as a cheap source of nitrogen and hydrogen. This is of interest particularly to the steel industry where the cracking of ammonia is carried out to provide an inert non-oxidizing atmosphere for the bright annealling of steel. Nitriding, a case hardening process, depends upon the dissociation of ammonia in contact with the metal being treated to form an extremely hard nitride casing. The process is carried out at a comparatively low temperature so that distortion is avoided and the depth of case can be readily controlled.

Anhydrous ammonia and ammonia solutions can be readily handled in steel equipment without danger of contamination. Ammonia produced today is practically a C. P. product and contains no impurities worth mentioning.

Muriatic acid is related to nitric in the sense that nitre cake is often used as a raw material in combination with salt to produce muriatic. Nitre cake serves as a source of sulfuric and the use of nitre cake and salt as against sulfuric and salt serves as a means of regulating production of sodium sulfate and muriatic acid. The nitre cake reaction produces twice as much sulfate for a given amount of muriatic as does the straight sulfuric process. The process as carried out is a distillation of the mixture in a muffle furnace and the resulting muriatic acid is absorbed in water to form the acid. Muriatic is also made synthetically by the combination of hydrogen and chlorine. The uses of muriatic are many and comparatively small. Its disadvantage lies in the fact that in the pure state it is a gas and consequently it must be sold as a water solution. The maximum strength of solution which can be practically shipped is 35% and consequently the total acidity does not begin to compare with sulfuric which can be shipped at 90-100% strength. Muriatic, however, is a stronger acid than sulfuric in that it is ionized more completely in solution. On this account it is used often in pickling steel where bright finishes are desirable. Reactions can be carried out at a low temperature without danger of excessive pitting. Metal chlorides are usually more soluble than the corresponding sulfates. On this account muriatic is used as a pickle before galvanizing and for the tanning of kid leather. Muriatic is volatile and thus can be readily removed from material by heat treatment while sulfuric under the same conditions is concentrated in place and its action thereby aggravated. This property of muriatic permits its use in so-called gas carbonizing where woolen goods are subjected to an atmosphere of hdyrochloric acid gas at a comparatively low temperature. Carbonization of the cellulosic material present is readily brought about with minimum damage to the wool and the residual acid present is readily removed by heating. The advantage of aluminum chloride carbonizing lies in the fact that aluminum chloride is a source of muriatic and in the baking and drying operation the latter is volatilized from the goods after having accomplished carbonization, and is not concentrated on them as in the case of sulfuric acid. A whiter and more lofty wool results.

Muriatic is death to metals. The most satisfactory material for its shipment and storage found to date has proved to be rubber. Rubber lined steel tank cars, storage tanks and pipe lines are in every day use. Recently an alloy called Hastalloy has been developed which it is claimed, is suitable for handling muriatic under certain conditions.

Muriatic is a very good solvent for iron and great care must be taken to see that it does not become contaminated by excessive amounts. Very small amounts of iron will give a distinct color to muriatic acid solution and as a matter of fact this property can be used as a basis for a colorimetric method for the determination of iron in muriatic.

Salt Cake

The co-product of muriatic acid manufacture is salt cake, crude sodium sulfate. Salt cake contains appreciable amounts of iron, calcium, magnesium, salt and sulfuric acid. Its principal uses are as a source of alkali for the manufacture of sulfate pulp, the production of kraft pulp is a modification of this process, and for the production of sodium sulfide. It is the raw material for the production of Glauber's salt which is made by dissolving the salt cake, precipitating the iron, calcium and magnesium, neutralizing the acid by the addition of an alkali, filtering and crystallizing. True calcined Glauber's may be made from real Glauber's by heating to drive off the water of crystallization.

The most objectionable impurity in Glauber's salt is iron and in order that this may be as low as possible, it is the custom to treat the glaubers so that the final product is slightly alkaline. Glauber's of this type will remain free from iron and its solution can be readily handled in galvanized piping whereas an acid Glauber's will be high in iron to begin with and will undoubtedly pick up more due to contact.

Acetic Acid

Acetic acid is of importance to the textile industry. The production of this material is another process that has been hard-hit by synthetic methods. Formerly, entirely produced from acetate of lime which in turn was produced by the distillation of wood, now large amounts are made synthetically from acetylene. Appreciable amounts are still made from acetate of lime by reaction of this material with sulfuric acid. The use of muriatic

acid for this purpose has practically gone out of existence as it was found that acetic made in this way was appreciably high in iron and had a damaging effect upon colors when used in the dye bath.

Practically all of the acetic acid manufactured is used in the textile industry either for the production of cellulose acetate or for adjusting the acidity of dye baths. It is generally shipped in wooden containers altho the glacial material is free from excessive amounts of formic acid may be shipped in aluminum. Dilute acetic may be handled in rubber. Dilute solutions attack most metals slowly and this reaction is speeded up materially if air is allowed to be present. Lead pipe lines can be used if care is taken to see that they are always kept full.

Excessive amounts of sulfuric and iron in acetic acid cause trouble in the textile industry. Formic acid may be present but is not particularly harmful.

Bisulfite of Soda

Bisulfite of soda altho of more importance to the tanner has interest for the textile man. It is manufactured by treatment of a solution of soda ash or caustic soda with sulfur dioxide. It is used in tanneries as a reducing agent for chrome solutions. In the textile field it is used as a bleaching agent, as an antichlor and as a raw material for the manufacture of hydrosulfite solutions. The latter can be readily made from bisulfite by treatment with zinc dust and sulfuric acid, to form zinc hydrosulfite which may or may not be converted to the sodium salt by treating with sodium carbonate. Bisulfite solutions are most advantageously shipped, stored, and handled in lead equipment. Its most troublesome impurity is iron which however, can be kept very low in a well regulated process.

Sulfide of Soda

The manufacturer and user of sulfur colors must use sulfide of soda. Two methods of manufacture of this material are in use. In one, salt cake, sodium sulfate, is reduced to the sulfide by reaction with carbon at a high temperature. The crude reaction mass is leached with water to form a sodium sulfide solution from which in turn is crystallized or fused the final product. In the other process, barium sulfate, is reduced to barium sulfide by much the same method, the resulting sulfide is dissolved in a solution treated with soda ash to precipitate barium carbonate and leave behind a solution of sulfide of soda. The final product is generally marketed in 2 forms, either as the crystal, which contains about 32% Na_2S or the so-called fused which contains 62%.

Aside from its use in the manufacture and application of sulfur colors, sulfide is used extensively in the leather industry for removing hair from hides. Sulfide solutions are readily handled in steel equipment. Both the solid and the solution pick up oxygen more or less readily from the air and are oxidized to sulfates. Consequently they should be kept in tight containers. Crystal sulfide is quite pure containing only traces of polysulfide. The concentrated sulfide may contain iron in addition to polysulfide but iron is not generally objectionable inasmuch as it is insoluble in the alkaline solutions formed and can be readily filtered off.

Copperas Nitrate of Iron

A chemical of relatively small importance to the chemical manufacturer but of increasing importance in the textile field is so-called copperas nitrate of iron. This material is not a nitrate of iron as its name would imply but is really a solution of ferric sulfate, $Fe_2(SO_4)_3$. It can be made by the oxidation of copperas with nitric acid or by the leaching of iron oxide with sulfuric acid. It is available on the market as a solution of 47° baume strength containing 37% ferric sulfate. Its principal uses to date have been the production of mineral colors for awning cloth and the dyeing of blacks on silk. It is however becoming of increasing interest to print mills on account of the growing interest in the indigosol colors. These colors can be readily developed thru the use of C.N.I. solutions.

Solutions of this material are acid due to hydrolysis and concentrated solutions to be stored for long periods must be handled in lead equipment.

C.N.I. solutions contain as impurities small amounts of ferrous iron. This if allowed to become excessive results in dull awning shades but should cause no trouble to indigosol users as the reduction of ferric sulfate to ferrous sulfate is part of the process.

Conclusion

In conclusion I would like to point out three things:

1. Wooden tanks are suitable equipment for all these materials under the conditions of their ordinary use as dilute solutions. Wooden pipe lines are not such an easy matter however and these must be made of more rigid or more easily fabricated material. It will be noted that in many cases I have mentioned lead as being a suitable material for handling certain solutions. Lead is a very convenient metal from the standpoint of the chemical manufacturer who generally employs a number of lead burners. This is not true however for the ordinary mill and recourse must be had to alloys such as Duriron, Monel metal, chrome nickel steel, lead lined steel, and rubber lined steel as these lend themselves much more readily to erection and repair.

2. All materials which finally appear on the market in the solid state must at some time or other in their process of manufacture go thru a solution stage. As they are generally used in solution, it is evident that the omission of the solidifying step would be a convenience to both manufacturer and consumer. It is obvious that where the cost of crystallization is greater

than the cost of transportation, there will be a saving effected thru buying these materials in solution.

3. This point has to do with impurities and by impurities we mean in practically every instance, iron. The chemical manufacturer does his best to keep these impurities from reaching harmful limits. In many cases, however, he is kept in ignorance of the use to which the material is to be put and as a consequence is at a loss to know just what material to offer. I dare say, in a good many of these cases the user himself is ignorant of the effect of impurities on the quality of his goods. Cooperation along these lines would be a benefit to both manufacturer and consumer, as in many cases savings may be effected thru the avoidance of the use of a practically chemically pure material where it is not necessary. A good example of this is the case of sulfuric acid. Sulfuric acid produced for battery purposes is practically chemically pure and commands a correspondingly high price. There are cases in the industry where the use of such a pure acid is essential but there are many other cases where a higher limit of impurities may be tolerated without damage and a corresponding saving effected. For the benefit of both of us I know we could stand much more information along these lines.

Discussion

Q. Will you give us some information on Oxalic Acid?

A. I have no information,—we are not manufacturers of either Oxalic or Formic Acids. I'm sorry.

Q. How is Ferris Sulfate made today?

A. Ferric Sulfate is made in two ways, first by oxidizing copperas, and secondly by leaching iron oxide with Sulfuric Acid. Another point, Ferric Sulfate in solution is made in the basic form. The reason for that I cannot understand.

Q. It was used for silk dyeing in the basis form. Why?

A. So it would be attracted to the fiber—the more basic, the more it would be attracted to the silk.

Q. Has the chamber process of making Sulfuric Acid any advantage over the contact process?

A. No. The chamber process makes a weaker acid than the contact. The chamber process is capable of making an acid of about 75% strength, while the contact process makes an acid up to 100% strength. Perhaps the reason the contact process has not replaced the chamber process in a good many instances, is due to the fact that plants already equipped for the chamber process do not care to go to the expense of changing over to the contact equipment.

Q. Is the name of Glauber Salt used for both the anhydrous and the crystals?

A. Anhydrous is generally called True Calcined Glauber Salt. The raw material, salt cake, is sometimes called Anhydrous Glauber's Salt. This is a misnomer as Salt Cake is a long way from Glauber's Salt as far as purity goes.

Q. You mention the various allows, such as Hastalloy and Monel metal, being used for storage equipment for acids. Are the more expensive metals, such as Tantalum, used for this purpose?

A. I don't know of Tantalum's being used to any great extent.

Q. Aside from rubber, are there any other coatings used for lining metal tanks?

A. Glass is the only other lining that I can call to mind.

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Proceedings of the American Association of Textile Chemists and Colorists

Stainless Steel in the Textile Industry*

By **K. E. LUGER**
American Sheet & Tin Plate Co.

THE textile industry is an important user of the various common materials of construction for plant equipment. It regularly consumes appreciable quantities of wood, steel, copper, aluminum and alloys, particularly alloys of nickel and copper. Within the last few years the steel industry has made available a new material of construction, stainless steel, which seems destined also to find important, economical, large-tonnage applications in the textile industry.

The term "stainless steel" is now commonly used to cover a whole range of alloys of chromium and iron or chromium, nickel, and iron. Laboratory tests and experience indicate that the alloy, commonly known as 18-8 or 18 and 8, containing approximately eighteen per cent chromium and eight per cent nickel, is likely to prove the most economical alloy of the stainless steel series for general application in the textile industry. Therefore, in the short time alloted, we shall confine our discussion to this one alloy.

Being a stainless steel, that is, a metal highly resistant to corrosion, 18-8 will probably find its greatest application in uses where either corrosive conditions are severe or freedom from contamination of the products is highly important. An example of this latter sort is found in dye vats or dye machines where the corrosion resistance of 18-8 allows delicate colors to be applied without changes in hue. However, before discussing the chemical or corrosion resisting characteristics, it is perhaps desirable to consider briefly its mechanical properties, as compared with those of steel and copper:

Typical Properties of Annealed 18-8 Sheets as Compared with Copper and Common Steel

Tensile strength approximately twice that of plain steel and approximately three times that of copper.

Modulus of Elasticity (a measure of deflection under load) approximately the same as that of steel and roughly twice that of copper.

Surface hardness slightly greater than that of plain steel and appreciably greater than that of copper.

Specific gravity about the same as that of steel and approximately 12% less than that of copper.

In spite of its high strength, 18-8 can be readily formed and fabricated into practically any shape or design obtainable in plain steel. The methods used in forming or fabricating of copper, Monel metal, or ordinary steel, such as bending, deep drawing, spinning, forging, casting, hot and cold riveting, soldering, and welding, are applicable to 18-8, although certain fabricating precautions should be observed if maximum corrosion resistance is to be retained.

Although 18-8 offers a remarkable resistance to corrosion by a great range of media and conditions, it is not a corrosion panacea or cure-all. The textile industry is a consumer of practically every chemical produced, ranging from the heavy chemicals such as sulfuric acid, caustic soda, or soda ash to the specialized dyestuffs. In such an industry it is possible that almost any conceivable corrosive condition might be encountered. Fortunately, however, where chemicals which would be capable of seriously corroding 18-8 are used in the processing of textiles, the concentration and conditions are such that there are only a few cases where 18-8 will prove unsatisfactory. Perhaps a tabulation of some solutions commonly used in the textile industry and their effects on 18-8 might more clearly indicate its remarkable corrosion resisting characteristics than any general discussion:

Results of Laboratory Tests

NOTE:

"No effect" indicates that the weight loss is less than 0.1 gms. per sq. m. per hr.

"Very slight effect" indicates that the weight loss is between 0.1 and 1.0 gms. per sq. m. per hr.

"Slightly corroded" indicates that the weight loss is between 1.0 and 3.0 gms. per sq. m. per hr.

"Severely attacked" indicates that the weight loss is over 3.0 gms. per sq. m. per hr.

Reagent	*Concentrations and Conditions*	*Effect on* 18-8
Acetic Acid	All concentrations at room temperature	No effect
	All concentrations up to 50% at boiling point	No effect

*Presented at Meeting, New York Section, October 27, 1932.

Nitric Acid	All concentrations and temperatures except boiling concentrated acid	No effect
Mixed Acids	50% concentrated sulfuric acid plus 50% concentrated nitric acid at 140° F.	No effect
	at 200° F.	Very slight effect
	75% concentrated sulfuric acid plus 25% concentrated nitric acid at 140° F.	No effect
	at 200° F.	Very slight effect
	15% concentrated sulfuric acid plus 5% concentrated nitric acid plus 80% water at 140° F.	No effect
	at boiling point	No effect
Sulfurous Acid	Sat. solution cold at boiling point	No effect
Formic Acid	10% at room temperature	No effect
	at 160° F.	No effect
	at boiling point	Very slight effect
	50% at room temperature	No effect
	at 160° F.	Slightly corroded
	80% at room temperature	No effect
	at boiling point	Slightly corroded
Acetic Anhydride	Pure up to boiling point	No effect
Phenol	Pure up to boiling point	No effect
	Crude up to boiling point	No effect
Tartaric Acid	Up to 50% solution up to boiling point	No effect
Ammonia	Aq. solution Sp. Gr. 0.91 up to boiling point	No effect
Potassium Hydroxide	27% at boiling point	No effect
	50% at boiling point	Very slight effect
Sodium Carbonate	Up to Sat. solution cold at boiling point	No effect
Sodium Hydroxide	20% at boiling point	No effect
	34% at 212° F.	No effect
	at boiling point	Very slight effect
Sodium Peroxide	10% up to 200° F.	No effect
Sodium Sulfide	50% up to boiling point	No effect
Sodium Sulfite	50% up to boiling point	No effect
Sodium Chloride	Sat. solution at room temperature	No effect
	at 212° F.	Very slight effect
Sodium Sulfate	Sat. solution cold at boiling point	No effect
Oleic Acid (Olein soap)	300° F.	No effect
Hydrogen Peroxide	All concentrations	No effect (18-8 does not cause H_2O_2 to dissociate)
Sodium Hydrosulfate	Alkaline solutions	No effect
Sodium Bisulfite	Sp. Gr. 1.38 at room temperature	No effect
Nitrous Acid	Sp. Gr. 1.41 at room temperature	No effect
	5% at room temperature	No effect
Potassium Dichromate	3% at boiling point	No effect
Potassium Dichromate plus 1½% H_2SO_4	2½% at boiling point	No effect
Sulfuric Acid	Most concentrations and temperatures unless inhibitor present	Severely attacked
Hydrochloric Acid	All concentration at all temperatures except cold very dilute solution	Severely attacked
Calcium Hypochlorite	0.2% at room temperature	Very slight effect (Pitted)
Stannic Chloride	Sp. Gr. 1.21 at room temperature	Very slight effect
	at boiling point	Severely attacked
Stannous Chloride	Sat. solution cold at 100° F.	Very slight effect
	at boiling point	Severely attacked
Sodium Hypochlorite	0.2% at room temperature	Very slight effect

From the above data it will be noted that the 18-8 offers remarkable corrosion resistance except to sulfuric acid and to the halogen acids. In the case of exposure to sulfuric acid, especially dilute acid, it has been found that aerating the solution or the presence of other solutions, except halogen compounds, usually inhibits or lessens the attack on the 18-8. Nitric acid or nitrates are particularly beneficial in inhibiting the corrosive action of sulfuric acid on 18-8.

The stability of 18-8 has made possible its use under very severe corrosive conditions in both the chemical industry and textile industry. It is widely used in the manufacture of nitric acid and in nitrating and acetylating processes. Recently, a viscose rayon plant installed an 18-8 pipe line for caustic solutions in order to overcome iron contamination in the finished rayon. The 18-8 composition is also being successfully used in a pipe line for handling a 4% sodium-hypochlorite bleach solution at about 100° F.

We are confident that 18-8 will find use throughout the textile industry, but expect that the major applications will be for equipment used in dyeing and bleaching. Where wooden vats are being used, they generally can be replaced with 18-8 vats or machines which will offer all the advantages of a dense non-absorbing surface easily rinsed and cleaned. As an example of the advantage of 18-8 over wooden equipment in this respect, there is the case of a dye company replacing 16 wooden vats, used for different colors, with one 18-8 vat. Tests made to determine the effect of 18-8 on dyestuffs as commonly used indicate that we may expect very little trouble from this standpoint. Of almost 200 dye solutions of various types (acid colors, acid chrome colors, direct colors) tried in one test, only one solution had its color seriously affected by stainless. There were slight variations in shades on 24 other solutions, while the bulk of the colors were not in the least affected. Other tests indicate

that developed colors, basic colors, sulfur colors, and vat colors are unaffected by 18-8 equipment.

It is believed that the first large use of stainless in the textile industry will be for equipment used for wool dyeing since it is here that 18-8 shows its marked superiority over other common metals. Even the solutions using acid and dichromate generally show no change in color when in contact with 18-8 nor do such solutions appear to corrode the metal. In the case of dyeing of silk or cotton, stainless also has found considerable application, but progress perhaps will be slower here both because a larger percentage of the present equipment is of recent manufacture and because there are other metals available and in common use which are giving fairly satisfactory service.

Both because it is unattacked by hydrogen peroxide and because it does not cause the hydrogen peroxide to dissociate, increasing use undoubtedly will be made of 18-8 equipment with this bleaching agent. In the case of hypochlorite bleaching, we believe 18-8 will find successful use, but this very likely will demand close control of the solution and careful handling of the equipment.

Another application of 18-8 which we feel is economical is its use for silk steaming or soaking bobbins or spools as well as soaking tanks. These spools are now being produced in quantities and offer the advantages of corrosion resistance, requiring less time for the operation. being easily and quickly cleaned, having no tendency to take on tints, and being practically indestructible.

Hosiery drying forms of 18-8 illustrate another important use of this alloy in the textile industry. Here advantage is taken of the metal's stainlessness, strength, and toughness, and the ease with which it can be formed.

We would suggest to textile chemists that they obtain samples of 18-8 which they can test under actual operating conditions in their plants—a pail or pot for use around the laboratory is often a convenient means of testing—and then apply it to equipment where they find it suitable. From experience gained in other industries, the producers of 18-8 would suggest that at least the initial fabrication of any 18-8 equipment be done under the supervision of the producers' metallurgists so that the maximum corrosion resistance of the material may be preserved.

Discussion

Chairman Herrmann: Thank you, Mr. Luger.

Gentlemen, you have heard the very interesting address upon the application of stainless steel in this industry. If you have any questions I am sure Mr. Luger will be glad to answer them. This is your opportunity. It is much quicker than doing it by correspondence.

Mr. Luger: I am sure Mr. LaQue has something to say.

Mr. LaQue: Why pick on me? I don't know whether I should say anything for publication or not inasmuch as anything I might say is obviously going to be prejudiced (laughter) since we produce competing materials, Monel metal, and pure nickel, and since at the same time we sell Mr. Luger's firm some nickel which they use in the manufacture of their Stainless Steel. (Laughter).

However, I believe that there is room for both materials in the industry, that their properties are so fundamentally different, the one being especially useful for oxidizing conditions and the other more especially useful for reducing conditions, that after a certain amount of, I might say, fooling around things will reach a proper level and we will each get our proper share of the business.

Of course, we are not going to give up the oxidizing field without a little bit of a struggle and we have ourselves introduced a new alloy of chromium and nickel which is free from the objections to Monel metal occasionally met with in the dyeing of acid chrome colors, where the oxidizing nature of the solution induces slight corrosion of the metal, which affects certain colors that are sensitive to metal salts. This difficulty is not as extensive as some of the more enthusiastic salesmen for Stainless Steel would have us believe. For example, tests by a prominent European dyestuff manufacturer on 196 chrome acid colors showed that only 6 were affected by Monel to any noticeable extent, and only one of the 6 seriously.

However, as I said before, in such cases where Monel metal is not considered adequate this new alloy known as Inco Chrome-Nickel might be used—either that or the Stainless Steels as suggested by Mr. Luger. (Laughter).

There is one other point which is a fundamental characteristic of the Stainless Steels and that is their sensitivity to the oxidizing power of the solution to which they are exposed. This may lead in some cases to pronounced variations in performance from plant to plant, or from laboratory to plant, depending, of course, on the oxidizing power of the solution with which the metal will be in contact, and it is going to be hard to predict just what will happen in any given case. This, of course, refers to the sulfuric acid and hydrochloric acid conditions which Mr. Luger mentioned.

Aside from these few remarks, which are probably more than I should have said, I have nothing further to say in discussion of Mr. Luger's very excellent paper.

Chairman Herrmann: Thank you.

Are there any further questions?

I was going to ask Mr. Luger why he had selected the wool dyeing particularly as a field for Stainless Steel in view of the fact that weak sulfuric acid seems to be one of the most energetic reagents that will corrode it.

Mr. Luger: You generally have some other sulfates

present when you use sulfuric, and those other sulfates tend to inhibit the corrosion. I also understand that, in dyeing, the solutions are generally agitated. If you agitate with air the rate of corrosion is negligible for the application. At least, the colors are unaffected and the corrosion rates are very low.

Chairman Herrmann: Is the same thing true, say, of the diazotizing reaction where we use hydrochloric acid and sodium nitrate?

Mr. Luger: I can't answer that.

Chairman Herrmann: You mentioned that in developed colors you thought it had an application.

Mr. Luger: Yes, the statement was based on actual tests in developed colors. I do not recall how these colors were applied.

I should say that when using Stainless equipment if you can keep away from hydrochloric acid, getting your acidity from some other means, it would be preferable.

Chairman Herrmann: The other one was sulfuric. You use either muriatic or sulfuric—

Mr. Luger: Sulfuric is a whole lot less harmful to the 18-8 than the hydrochloric. We were not worried about the sodium nitrate. That doesn't worry us at all. In fact, the presence of sodium nitrate would perhaps completely inhibit the corrosion of the sulfuric acid. It gives you an oxidizing condition which is desirable.

We picked out the wool dyeing both because, as far as we can see the picture now, the silk and cotton industries are pretty well equipped with modern equipment built of Monel which is well established in those fields, and because we naturally would pick the fields in which we thought we could get the most tonnage with a given amount of effort. We are not leaving silk and cotton dyeing to the International Nickel Company to develop alone. We are going to get after those, too. (Laughter). But we think that the wool dyeing industry is the easiest place for us to start. Experience gained there and good results attained there will help us in going after the equipment manufacturer that build equipment for the silk and the cotton dyeing industries.

Mr. Joseph S. Lange: I should like to ask you how far you have gone on the chrome colors.

Mr. Luger: To be perfectly frank with you, the steel companies themselves have done very little testing on the dyestuffs. The data we have has come principally from tests made by the makers of dyestuffs.

In one series of tests something like seventy-six different chrome colors were applied in the presence of 18-8. Of these 76 colors, none of the shades were affected by the stainless.

Mr. Lange: None?

Mr. Luger: None. There were some that had their shades changed, but such changes were very slight.

I might add that in one series of tests conducted by a manufacturer of dyestuffs, approximately 200 different dyes were used to determine the effect of various metals on the shades produced. In these tests there were included cast iron, wrought iron, plain steel, brass, phosphor-bronze, copper, nickel, Monel metal, a type of Stainless Steel other than 18-8, and 18-8 from three different sources. It was found that 18-8 had no effect whatsoever on most of the colors, and of those few colors which had their shades slightly affected by the Stainless, the change in shade was less pronounced than when Monel or nickel were used. In other words, in these tests of the acid colors, acid chrome colors, and developed colors, Stainless in the case of every dyestuff ranked either above or equal with nickel or Monel.

Mr. Lange: Do you recall whether they were made chrome bottom, chrome top, and middle?

Mr. Luger: I don't know, frankly. Perhaps Mr. LaQue can answer that.

Mr. LaQue: I think I am familiar with the tabulation to which Mr. Luger refers, although I am not familiar with the details of the testing procedure, other than I think it was made by only one procedure. Just which one it was, I couldn't say. I have an idea that they picked the worst condition which I presume would be the bottom chrome*, would it not?

Mr. Lange: Yes.

Mr. Alling: Mr. Luger, have you made any tests on the dischargeability of diazotizing developed grounds dyed in your 18-8?

Mr. Luger: I am afraid you will have to translate that for me. (Laughter).

Mr. Alling: Well, I have had the experience in dyeing diazotizing developed work in Monel metal jigs that the grounds wouldn't discharge as well as it would if it were dyed in a wooden jig, for instance. I was wondering how the 18-8 would act in that respect.

Mr. Luger: I will tell you frankly I don't know and I believe the only way to get an answer to that is to try it. If you can try it in a laboratory beaker or pot made of 18-8, that is what we would suggest you do.

We are perhaps leaning over backwards to prevent misapplication of the 18-8, particularly at this early stage. We should like to have every textile chemist get hold of one or two 18-8 pots that he could use around his laboratory.

Could you, if you had a pot, run a test like that?

Mr. Alling: Yes, that could be done.

Mr. F. Schlayer: I should like to ask Mr. Luger if he has ever made any tests with tannic acid?

Mr. Luger: Yes. I believe I neglected to mention that. I don't believe I mention it here in this list, but data

* Check-up after the meeting showed that tests on chrome colors referred to were made in an "after chroming" process.

we have shows that in the presence of tannic acid 18-8 stands up, I think, perfectly—if not perfectly, very nearly so. I can check that up and drop you a line about it.

Mr. Schlayer: I will tell you why I ask that: because the other steels, particularly on tannic mordanted cotton or tannin mordanted rayon, have a tendency to dull the shades. I was wondering whether the 18-8 did the same thing.

Mr. Luger: I shall have to check that up and will be very glad to drop you a note on that.

Chairman Herrmann: Gentlemen, are there any further questions? I think as Mr. Luger intimated the answer to the thousand and one questions that remain unanswered in everyone's mind will come from practical application, as Mr. Luger said that in the laboratory many corrosion tests prove to be far more severe than they are in practice. There is one comfort there. The steel industry is acquainted with the use of inhibitors. An inhibitor in the steel industry is a chemical that might be added to an ageing bath that will permit chemicals to remove oxides without corroding the metal itself. Among these inhibitors there are many organic compounds that we are familiar with as dyes. So fortunately in the actual dyeing operation we are introducing an inhibitor that protects the Stainless Steel. Which of the dyes are inhibitors and which are not inhibitors practice will eventually show.

I am not prepared to speak further on this subject. (Laughter).

If there are no further questions, I think the hour is late enough so that we might adjourn and if so, I will call for a rising vote of thanks for the speakers of the evening.

. . . Upon motion duly made and seconded, it was voted to extend a rising vote of thanks to the speakers. . . . (Applause)

. . . The meeting thereupon adjourned at ten-five o'clock. . . .

JANUARY MEETING, NORTHERN NEW ENGLAND SECTION

THE second bi-monthly meeting of the Northern New England Section was held Jan. 14th at Shawsheen Manor, Shawsheen Village, Andover, Mass. with Chairman Leverett N. Putnam presiding. The usual dinner preceding the meeting was attended by 55 members and visitors. The meeting itself was attended by 69. During the business session, the sectional committee was authorized to nominate a Councilor to be voted on at the next meeting in March in accordance with the new constitutional amendment adopted by the last Annual Convention, which is expected to be ratified by the several sections by that date.

Chairman Putnam then introduced Mr. W. W. Bray, Director of Laundry & Textile Research of the Procter & Gamble Co. who gave a very interesting and instructive talk on "Getting the Most Out of Soap." Mr. Bray's up-to-date presentation of this ancient subject evoked an enthusiastic discussion of both laboratory and plant procedures involving soaps.

After the discussion of Mr. Bray's paper, Prof. Olney entertained the meeting with a brief report of the Annual Meeting at Greensboro, N. C.

The next meeting will be March 11th at Cambridge.

Respecfully submitted.

CLARENCE L. NUTTING, *Secretary.*

AMERICAN
DYESTUFF
REPORTER

LOUIS A. OLNEY, Sc.D.
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

NORMAN A. JOHNSON
Managing Editor

MYRON DREW REESER
Advertising Manager

Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES
President

M. D. REESER
Secretary

H. F. CRAWFORD
Treasurer

Subscription price: $5.00 per year; Canadian $6.80; foreign $6.00

Vol. XXII January 30, 1933 No. 3

FUTURE PROSPECTS

MANY significant remarks are contained in a statement released by Roy D. Chapin, Secretary of Commerce, in response to requests for a statement of conditions at present and prospects for the future. Its conclusion notes an optimistic outlook for the future to be caused, at least in part, by the improved mental attitude of the American public. Mr. Chapin does not wish to be considered as over-emphasizing this intangible aspect of the business situation but he does believe its existence is significant. Among the points brought out in his concluding paragraph are the following:

Hysterical, panicky pessimism, wherever it may have existed among our people, have been replaced by a more American attitude. The dominant mood today is vastly calmer and more rational. Quiet determination rules. We see penetrating analyses of our current business ills —a clearer understanding of the complex maladjustments. There is a keener receptivity to soundly constructive proposals. Intellectually, as a nation we are certainly better equipped than we were at the beginning of 1932 to proceed with our vital task of scientifically reducing the costs of production and distribution, on the one hand, and, on the other, of building up the earning and buying power of our great domestic market.

In developing the note of optimism expressed in the above words both the unfavorable and favorable conditions were considered. Under unfavorable developments we find the following:

Many of our factories and mines were idle in 1932 and a large number were operating on a part time basis. Crops were good in yield but the marketing prices were in many cases below the average cost of producing them. Foreign trade values were below our pre-war levels. The national commodity prices declined and the domestic debt problem became even more acute. Wholesale and retail trade reported a very unfavorable year and bank credit was further restricted. Especially depressing were the number of failures of banks and similar commercial houses. The number of unemployed persons—ever important—was estimated to have been about 11,000,000. When the course of trade during various periods of the past year was considered it was found that up to July the trend of most commercial indicators was downward. In August, however, definte signs of improvement were witnessed particularly in respect to prices and in those industries manufacturing consumer goods. From August to November the trend of business was upward but since then the advance has been curtailed due in part to seasonal influences. The total number of freight car loadings decreased about one-fourth from the level of the preceding year. It is explained, in this connection, that because of the development of pipe lines and other means of transportation such as motor trucking, these figures are less indicative than they would otherwise be. The expenditure for construction during 1932 was estimated by the Federal Employment Stabilization Board to have totalled about $4,400,000,000 in comparison to $7,600,000,000 for 1931. In this case again there are other factors to be considered: mainly, the lower level of construction costs. Exports declined just a little under 20% in quantity during 1932 and imports were decreased about 16%. In values these represent 33% for exports and 37% for imports.

So much for the leading unfavorable items and now the consideration of favorable conditions and developments should be noted.

In considering our financial dealings with other nations we should emphasize the successful defense of the dollar at a time when many nations found it necessary to relinquish the gold standard and allow the values of their currencies to rise and fall with the changing tides of world conditions. Legislation has been passed by Congress which has been helpful in preventing further deflation, and recent vigorous resistance to further deflation is encouraging. The Reconstruction Finance Corporation has effectively reduced the volume of liquidation. Other measures were also enacted to bring about a betterment of business conditions. The United States has continued to hold its position as the world's leading exporter and the shipments of raw cotton to the Far East and Europe were heavy enough to total about four and one-half billion pounds, the largest amount since 1928. Wholesale prices were comparatively steady and the December averages were only slightly lower than a year previous. In the last quarter of the year security prices were not much below the values of the first quarter. Many workers have returned to work through the functioning of the Share-the-Work Movement. Industrial

disputes were less frequent than at the boom in 1929 or the depression of 1920-1921. It is also brought out that the very severity of the depression has brought about a better understanding between employer and worker. Among the conditions which will bring about actual buying when the proper time comes we find the following:

A great deal of industrial equipment has become obsolete and must be replaced by new and more efficient machinery. Stocks of goods in retail stores have been materially reduced. Stocks of necessities in consumers' hands are extremely low. Supplies of consumers are deteriorating. In short, the situation can be summed up in the following words: "The need for goods is there; the task is to translate it into actual buying." To this we might add: "And when you buy, buy quality."

Such are the facts and conditions now facing us. One thing that we think we all have reason to be thankful for is the fact that we believe we have all learned a great deal from this depression—let's not forget it.

Textile Courses at Columbia

Columbia University, through its University Extension Department, will offer courses in textiles in the coming Spring Session. Such courses have been conducted by the University for the last sixteen years. The purpose of these courses is to offer a general working knowledge of the various branches of the industry, and they are especially designed for executives, converters, jobbers, merchants, buyers, and salesmen. The lectures are also of interest to women who are using materials in a professional way as stylists, designers, decorators, and modistes.

Students who are thinking of taking these courses may obtain information on Thursday or Friday evening, February 2 or 3, between 7:30 and 9:00 in Room 301, School of Business, northeast corner of 116st Street and Broadway. Such consultation will aid the students in selecting the courses best suited to their needs. Registration for the Spring Session will begin on February 2. No examinations are required for admission. Those who desire to visit courses at the beginning hour may secure permission from the office of the Director, Room 301, School of Business.

Rayon Course

The evening lecture course on the manufacture, weaving and converting of rayon and other synthetic yarns and fabrics at Columbia University will be opened for new students on Thursday, February 9th, at 7:30 P. M. in Room 410, Mines Building, 116th Street and Broadway, this city.

The course, now in its third year, covers the history, importance and growth of the rayon industry; the four important processes of manufacturing rayon yarns; the identification and testing of rayon yarns; processes preliminary to weaving and knitting; the weaving and knitting of all types of rayon fabrics; weaves and construction details; the dyeing and bleaching and printing of the various types of rayon cloths; and the many finishes and machinery used.

No examination is required and the course is especially designed for salesmen, buyers, executives, jobbers, converters and mill representatives, who wish to familiarize themselves with this new textile. H. R. Mauersberger, formerly with the Celanese Corporation of America, is instructor.

Cotton Goods Converting Course

Columbia University also wishes to announce that the evening course in the dyeing, printing and finishing of cotton goods will be opened to new students on Friday evening, February 10th, at 7:30 P. M. in Room 410, Mines Building, 116th Street and Broadway. H. R. Mauersberger is also instructor in this course.

The course consists of fifteen lectures and is illustrated with moving pictures, actual samples and trips to nearby plants. It covers the growth and magnitude of the dyeing and finishing industry; the physical and chemical properties of cotton goods; preparatory operations; the various bleaching processes; mercerization and piece dyeing of all types of cotton goods; shrinking methods; special processes, such as moreing, calendering, schreinering, and embossing. Analysis and testing of grey and finished cottons as well as merchandising and selling will be taken up in detail. Special attention will be given to rayon and cotton mixed fabrics.

No examination is required and the course should be of interest to anyone in the converting trade. Visitors are always welcome.

Awarded Perkin Medal

The Perkin Medal was presented to Mr. George Oenslager of the B. F. Goodrich Co. at a meeting of the American Section of the Society of Chemical Industry and other cooperating societies, held in the Electrical Institute Auditorium, Grand Central Palace, New York, on January 6, 1933. The award was made for Mr. Oenslager's contributions to the rubber industry. He presented an address describing the development of organic accelerators for rubber vulcanization. Mr. Alfred P. Jones of the Houston Properties Corp. described the work and accomplishments of Mr. Oenslager that led to the award. Prof. Marston T. Bogert, Past President of the Society of Chemical Industry, made the presentation.

R. & H. With Du Pont

Effective January 1, 1933, the business heretofore conducted by The Roessler & Hasslacher Chemical Co., Inc., will be continued as a department of E. I. du Pont de Nemours & Company, Inc., and will be known as The R. & H. Chemicals Department. Correspondence, inquiries and orders should be directed to the nearest branch office which will handle your business as in the past.

Textile Foundation News

Color Vision Machines

Machines which perform the functions of the eye and brain in color-vision have been developed in the Color Measurements Laboratory at the Massachusetts Institute of Technology and are being applied to textile color problems by Professor Arthur C. Hardy and O. W. Pineo, a research Fellow of the Textile Foundation.

The Spectrophotometric Analysis of Dyed Materials is a broad description of the research work of Mr. Pineo, whose statement on the significance and progress of the undertaking is made available by Franklin W. Hobbs, Chairman of the Board of Directors of the Textile Foundation.

Describing and illustrating his work, Mr. Pineo goes on to say that if some skilled surgeon were to install in the human brain some little meters to measure the color-sensation, many of the perplexing color problems of the industry would be well on the road to solution. This would be the most direct and powerful method of attack, because our interest in color lies in its effect on us as observers, and the meters would overcome the present lack of a yardstick with which to measure and rationalize this effect.

The memory is very poor for colors and even samples change with time, but the vast amounts of practical experience which are now wasted because we cannot describe and preserve the results of our experiments might be saved through meter readings systematically filed. A yardstick for color would make possible accepted limits to settle the frequent divergencies of opinion on matches and to grade the ability of textile materials to withstand exposure to sunlight and laundering. More fundamentally, a numerical specification of colors would lend itself to study of their origin, their dependence on dyeing processes and dye concentrations, and to further investigation of the physiology and psychology of color vision.

Of course science can not at present measure with meters the color excitation in our brains, but it can perform with other means than eyes and brains all the essential processes of color vision and measure the results. This requires the collaboration of both the physicist and the psychologist.

The physicist says that light, the agency producing the sensation of color, is a wave motion and that all colors are made up of the spectrum colors which are fundamental and differ from each other only in the frequency of their vibration. By means of a prism the light coming to the eye from a "colored" object can be separated into its fundamental constituents and a spectrophotometric curve showing the amounts of each is a complete description of the "color" from the point of view of the physicist, but obviously it says nothing about what the color *looks like*.

To determine the appearance of a color the psychologist demonstrates that any stimulus whatever falling on the eye can be matched by three arbitrarily chosen primary stimuli when added together in the proper amounts. If two colors are matched by the same amounts of the primaries they look alike, even if their spectrophotometric curves are different which is often the case, and if by different amounts they look different.

The three numbers giving the amounts of the primaries to match a given color are the meter readings that are desired, and they can be gotten from the spectrophotometric curve furnished by the physicist. The amounts of primaries are known which match unit amount of each of the physicist's fundamental constituents, the spectrum colors. By simply adding up the amounts to match the constituents separately one gets the amounts to match the whole stimulus. This computation can be done mathematically with the help of an integraph. The choice of primaries has been internationally standardized, so that the result of the color determination is three numbers which *define* what the color *looks like*.

This process of determining the spectrophotometric data and integrating it is the analogue of vision and answers directly the question "Do these look alike or different and how much?" Yet the "seeing" is done by an integraph which is not subject to the wide variations of color vision which exist from person to person, since it incorporates internationally standardized average data insuring consistent results in different laboratories.

The measurement of color in this way has hitherto been handicapped by the labor necessary to obtain the spectrophotometric curve and perform the computations, since only a few samples could be measured in a day. But the recent development of integraphs and rapid and accurate spectrophotometers at the Massachusetts Institute of Technology makes possible its application in the work of the Textile Foundation on the many color problems of the textile industry.

Polarized Light

Man has great use for cotton and other fibers because they possess desirable properties. Two of the most important of these properties are strength and ability to take on color, and the textile industry is quite interested in knowing all it can about these properties and how they

are related to the structure of the fiber. The manner in which the molecules and micelles which make up a fiber are oriented, or lined up, has a good deal to do with these two properties, and on this point some very useful information may be obtained by a study of fluorescence, and of polarized light.

So observes Dr. Donald R. Morey who, under the direction of Dr. Ernest L. Merritt at Cornell Univesity, is giving full time and attention to research on the general subject of the Application of Polarized Light to Textile Research.

Such highly scientific study is little understood by the manufacturer, merchant and consuming public but its importance to all concerned is undeniable, according to Stuart W. Cramer, Director and Treasurer of the Textile Foundation. Dr. Morey's work as a Foundation Research Fellow is one of several similar projects sponsored by the Foundation, and in order to make the import of this particular study clearer to the general public, Mr. Cramer has made available Dr. Morey's statement, which continues in part as follows:

In the study of orientation of the fiber, fluorescent dyes are used to dye the fiber. When dye molecules are taken up by the fiber, it is because there are forces of attraction between the molecules of dye and fiber. (There is some debate among scientists whether or not to call these forces chemical.) However, if the fiber molecules lie in a random fashion, it is to be expected that the dye molecules will be held in a helter-skelter fashion, and if the fiber molecules are lined up, there should be an orientation or alignment of the dye molecules. At this point the ability of the dye molecules to fluoresce is extremely useful. If the dye molecules are scattered through the fiber at random, the fluorescent light will be unpolarized; if they are completely lined up, the fluorescent light will be completely polarized, and for any degree of alignment of the molecules there corresponds a certain amount of polarization of the fluorescent light.

Since individual fibers are examined, it is of course necessary to use a microscope, with special attachments for the measurement of the percent polarization.

Chemical Division Bulletins

Following is a partial list of statements to be issued during the coming year by the Chemical Division of the Bureau of Foreign and Domestic Commerce. Prices of subscriptions are indicated.

2801—*U. S. Exports of Coal Tar Products and Dye Materials* $1.00
Logwood extract, other dye extracts, benzol, crude coal tar, coal tar pitch, cresote oil, colors, dyes and stains, and other coal tar products. Mimeographed 2 sheets.

2805—*U. S. Exports of Industrial Chemical Specialties—Specific Classes* 1.00
Rubber compounding agents, cementing preparations, textile specialty compounds, water softeners, metal working compounds, industrial specialty cleaning preparations, other chemical specialty compounds, household washing powders, metal and stove polishes, floor wax, and furniture polishes, auto polishes, and matches. Mimeograph, 2 sheets.

2806—*U. S. Exports of Inorganic Acids, Compressed Gases and Gas Blacks*..... 1.00
Hydrochloric acid, boric acid, other inorganic acids, ammonia anhydrous, chlorine, other gases, bone black, and carbon black. Mimeographed 2 sheets.

2807—*U. S. Exports of Synthetic Organic Chemicals* 1.00
Organic acids, methanol, butanol, other alcohols, acetone, carbone bisulphide, formaldehyde, citrate of lime, and other organic chemicals. Mimeographed 2 sheets.

2808—*U. S. Exports of Certain Industrial Chemicals* 1.00
Aluminum sulphate, other aluminum compounds, calcium carbide, calcium chloride, hydrogen peroxide, potassium compounds, sal soda, and tin compounds. Mimeographed 2 sheets.

2809—*U. S. Exports of Sodium Compounds*..... 1.00
Bichromate and chromate, cyanide, borate, silicate, bicarbonate, hydro-oxide, and phosphate. Mimeographed, 2 sheets.

2816—*U. S. Exports of Naval Stores and Linseed Oil* 1.00
Gum rosin, wood rosin, gum spirits of turpentine, wood turpentine, tar and pitch of wood, other gums and resins, linseed oil and pine oil. Mimeographed 2 sheets.

2817—*U. S. Exports of Crude Drugs, Essential Oils, Glue and Dextrine*..... 1.00
Ginseng, other crude vegetable drugs, peppermint, spearmint, orange and other citrus oils, dextrine or British gum and glue of animal origin. Mimeographed 2 sheets.

2855—*U. S. Imports of Coal Tar Products and Natural Dyeing and Tanning Materials*.... 1.00
Dead or cresote oil, benzine, cresylic acid, naphthalene, tar and pitch, logwood, annatto and extracts of, cochineal, saffron, tumeric, and logwood extract. Mimeographed 2 sheets.

2856—*U. S. Imports of Specified Industrial Chemicals* 1.00
White arsenic, ammonium chloride (white and gray), ammonium nitrate, barium compounds, cobaltoxide, copper sulphate, arsenic sulphide, iodine, radium salts and radio active substitutes, iron compounds, lead compounds, antimony compounds, and zinc compounds. Mimeographed 2 sheets.

The European Dye Cartel in World Trade

(Continued from page 74)

Although the subject of interchange of technical information is one on which there is a scarcity of data, its inclusion in dye pacts emphasizes the importance of research as a factor in international dye trade. International dye competition has been intensified by the production of many simple identical dyes by several countries. The trend has been towards high priced specialty dyes as a factor in obtaining a share of the world trade. Both reduced costs and new color production hinge largely upon research, involving trained personnel and a comprehensive program covering a period of years and it is this factor which is becoming increasingly important in the achievement of success in the highly competitive field of dye marketing at home and abroad.

The following tables detail the export trade of the principal producing countries, showing their relative positions in world markets as well as the comparative status of consuming areas in the individual trade of each producer country.

Summary

Table No. 1—World Dye Export Distribution—By Consuming Areas

Total Exports (X)— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	101.3	32.5	72.8	81.9	96.2	90.1	89.4
Europe	73.2	61.6	43.8	49.2	60.0	52.6	47.8
North America	43.0	7.4	6.2	6.2	11.2	8.8	8.6
South America	2.4	2.5	2.8	2.1	2.7	2.4	2.7
Africa	1.7	0.9	0.9	1.4	0.8	0.8	0.4
Oceania	0.4	1.2	1.1	1.4	1.4	1.1	1.4
N. E. S.	44.4	[2]1.0	0.5	1.2	3.3	3.8	[3]10.0
Total	266.4	107.1	128.1	143.4	175.6	159.6	160.3

Exports from Germany— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	94.9	18.1	40.5	48.3	48.4	51.4	57.1
Europe	61.2	39.0	28.5	30.0	37.7	32.8	32.1
North America	37.7	2.0	2.4	1.5	6.1	4.8	4.5
South America	2.2	1.6	2.0	1.3	1.7	1.7	2.0
Africa	1.5	0.5	0.2	0.6	0.5	0.5	0.4
Oceania	0.4	..	[1]	0.2	0.2	0.2	0.2
Other and N. E. S.	42.2	0.3	0.3	..	0.1	0.1	0.1
Total	240.1	61.5	73.9	81.9	94.7	91.5	96.4

Exports from United States— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	..	..	15.0	20.4	28.8	22.8	16.2
Europe	..	..	0.4	2.3	2.3	2.8	1.7
North America	..	..	1.9	2.5	2.3	2.2	2.0
South America	..	..	0.5	0.5	0.6	0.4	0.4
Other	..	..	0.1	0.1	0.1	0.1	..
Total	..	[3]	17.9	25.8	34.1	28.3	20.3

Exports from Switzerland— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	5.5	5.5	9.0	5.8	5.7	4.7	4.8
Europe	10.2	15.5	7.6	9.4	13.3	11.4	11.5
North America	3.5	1.9	1.1	1.7	2.4	1.5	1.8
South America	0.2	0.6	0.3	0.3	0.4	0.3	0.3
Other	0.1	0.3	0.3	0.1	0.1	0.1	0.1
Total	19.5	23.8	18.3	17.3	21.9	18.0	18.5

Exports from Great Britain— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	0.2	5.0	5.0	2.8	10.7	5.6	6.8
Europe	0.6	5.2	2.4	1.0	1.5	2.0	1.9
North America	1.8	1.5	0.4	0.3	0.2	0.2	0.3
Africa	[1]	0.1	0.1	0.1	0.1	0.1	[1]
Oceania	[1]	1.0	1.0	1.0	1.2	0.9	1.2
Other & N. E. S.	1.9	1.0	0.3	0.8	1.5	1.4	1.7
Total	5.5	13.8	9.2	6.0	15.2	10.2	11.9

Exports from France— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	0.6	3.9	0.7	3.6	0.8	1.0	..
Europe	0.3	1.0	4.0	4.0	4.4	3.0	..
North America	[1]	2.0	[1]	0.1	0.2	[1]	..
Africa	0.2	0.2	0.2	0.6	0.1	0.2	..
Other & N. E. S.	0.1	0.1	0.1	0.5	0.3	0.4	..
Total	1.2	7.2	5.0	8.8	5.8	4.6	[3]6.7

Exports from Japan— *To:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Asia	..	..	2.3	1.0	1.8	4.6	4.5
Total	..	..	2.3	1.0	1.8	4.6	4.5

[1]Too small to be shown separately. Included with "Other and N. E. S."
[2]No quantity figures available for United States exports in 1920.
[3]French exports by countries for 1931 not available. Total exports included in figures marked.

Table No. 2—Sources of World Dye Supply—By Exporting Countries

Total Exports (X)— *From:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Germany	240.1	61.5	73.9	81.9	94.7	91.5	96.4
United States	..	[1]	17.9	25.8	34.1	28.3	20.3
Switzerland	19.5	23.8	18.3	17.3	21.9	18.0	18.5
United Kingdom	5.5	13.8	9.2	6.0	15.2	10.2	11.9
France	1.2	7.2	5.0	8.8	5.8	4.6	6.7
Japan	..	..	2.3	1.0	1.8	4.6	4.5
Other	0.1	[1]0.8	1.5	2.6	2.1	2.4	2.0
Total	266.4	107.1	128.1	143.4	175.6	159.6	160.3

Exports to Asia— *From:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Germany	94.9	18.1	40.5	48.3	48.4	51.4	57.1
United States	..	[1]	15.0	20.4	28.8	22.8	16.2
Switzerland	5.5	5.5	9.0	5.8	5.7	4.7	4.8
Great Britain	0.2	5.0	5.0	2.8	10.7	5.6	6.8
France	0.6	3.9	0.7	3.6	0.8	1.0	[3]
Japan	..	..	2.3	1.0	1.8	4.6	4.5
Other	0.1	[1]	0.3	..	..	..	[3]
Total	101.3	32.5	72.8	81.9	96.2	90.1	89.4

Exports to Europe— *From:*	1913	1920	1923	1926	1929	1930	1931
	Millions of Pounds						
Germany	61.2	39.0	28.5	30.0	37.7	32.8	32.1
United States	..	[1]	0.4	2.3	2.3	2.8	1.7
Switzerland	10.2	15.5	7.6	9.4	13.3	11.4	11.5
Great Britain	1.6	5.2	2.4	1.0	1.5	2.0	1.9
France	0.2	1.0	4.0	4.0	4.4	3.0	[3]
Other	..	[1]0.9	0.9	2.5	0.8	0.6	[3]0.6
Total	73.2	61.6	43.8	49.2	60.0	52.6	47.8

Exports to North America—

From:	Millions of Pounds						
	1913	1920	1923	1926	1929	1930	1931
Germany	37.7	2.0	2.4	1.5	6.1	4.8	4.5
United States	..	[1]	1.9	2.5	2.3	2.2	2.0
Switzerland	3.5	1.9	1.1	1.7	2.4	1.5	1.8
Great Britain	1.8	1.5	0.4	0.3	0.2	0.2	0.3
France	..	2.0	..	0.1	0.2	..	[2]
Other	..	[1]	0.4	0.1	..	0.1	[2]
Total	43.0	7.4	6.2	6.2	11.2	8.8	8.6

Exports to South America—

From:	Millions of Pounds						
	1913	1920	1923	1926	1929	1930	1931
Germany	2.2	1.6	2.0	1.3	1.7	1.7	2.0
United States	..	[1]	0.5	0.5	0.6	0.4	0.4
Switzerland	0.2	[3]0.9	0.3	0.3	0.4	0.3	[2]0.3
Total	2.4	2.5	2.8	2.1	2.7	2.4	2.7

Exports to Africa—

From:	Millions of Pounds						
	1913	1920	1923	1926	1929	1930	1931
Germany	1.5	0.5	0.2	0.6	0.5	0.5	0.4
Switzerland	..	0.1	0.3	..	0.1	..	..
Great Britain	..	0.1	0.1	0.1	0.1	0.1	[3]
France	0.2	[3]0.2	0.3	0.7	0.1	0.2	[2]
Total	1.7	0.9	0.9	1.4	0.8	0.8	0.4

Exports to Oceania—

From:	Millions of Pounds						
	1913	1920	1923	1926	1929	1930	1931
Germany	0.4	..	..	0.2	0.2	0.2	0.2
Switzerland	..	0.2	..	..	..	..	..
Great Britain	..	[1]1.0	1.0	1.2	1.2	0.9	[2]1.2
Total	0.4	1.2	1.1	1.4	1.4	1.1	1.4

N. E. S.	44.4	1.0	0.5	1.2	3.3	3.8	10.4

[1]Exclusive of U. S. exports for which no quantity figures are available.
[2]Exclusive of French 1931 exports for which details are not available.
[3]Too small to be separately shown.

Young Company Enters Dyestuff Field

Announcement is made by the J. S. Young Co. of Baltimore, Md., that they have formed a corporation known as the Young Aniline Works, Inc., for the purpose of entering upon the manufacture and sale of dyestuffs.

It is understood that this new factor in the dyestuff manufacuring industry will concentrate for the immediate future upon colors of the Azo group, especially direct colors. Distribution to the trade will be made through recognized dyestuff dealers.

In addition to certain individuals already connected with the Young Company, the personnel of the new corporation will include Arthur L. Benkert, Robert J. Grant, Edward Weston and others formerly associated with Noil Chemical and Color Works.

New York offices of the new corporation will be at 253 Broadway.

The J. S. Young Company is an old established firm in the manufacture of licorice and through its affiliated concern, J. S. Young & Company, of Hanover, Pa., is a very large factor in the production of logwood and other wood extracts.

New Laurel Branch

Increased service to the South is now available for Laurel Products through the American Brokerage and Warehouse Company, 505 S. Cedar Street, Charlotte, N. C. This gives the Laurel Soap Mfg. Co., Inc., of Philadelphia, two distributing points in the South—the new one in Charlotte, N. C., and the other which has been servicing for sometime in Chattanooga, Tenn.

American Aniline Cards

In addition to the recently issued Amanthrene vat printing color cards, the American Aniline Products, Inc., have recently issued four color cards:—

Amanil colors on rayon with discharge developed colors on rayon with discharge Amaply colors for printing—weighted silk Amanil-Amacid colors on tin weighted silk.

Several of the new colors shown in these cards will be of special interest in the printing and converting trade.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

CLASSIFIED

CHEMIST—Assistant dyer, 28 years of age, married; graduate Lowell Textile Institute, 2½ years' experience in laboratory of leading dyestuff concern. Familiar with uses and application of all classes of textile dyestuffs. Desires position in laboratory of dyestuff concern, mill or sales. Can go anywhere. Address: Box No. 747, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

Position Wanted—A laboratory assistant, 21 years of age, with some dye-house experience desires a position in dyestuff laboratory. Has studied textiles and is a graduate of Pratt Institute Technical Chemistry Course. References. Address Box No. 765, American Dyestuff Reporter, 440 Fourth Avenue, New York.

DYER—Cotton and Rayon Piece Goods Dyer seeks position. Years of experience on continuous and pigment vats, developed, indigosol, sulphur, direct and basic colors. Jiggs, pads or reel machines, all styles cotton and linen goods, crepes, celanese and mixtures. Technical institute graduate. Address Box No. 766, American Dyestuff Reporter, 440 Fourth Avenue, New York.

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